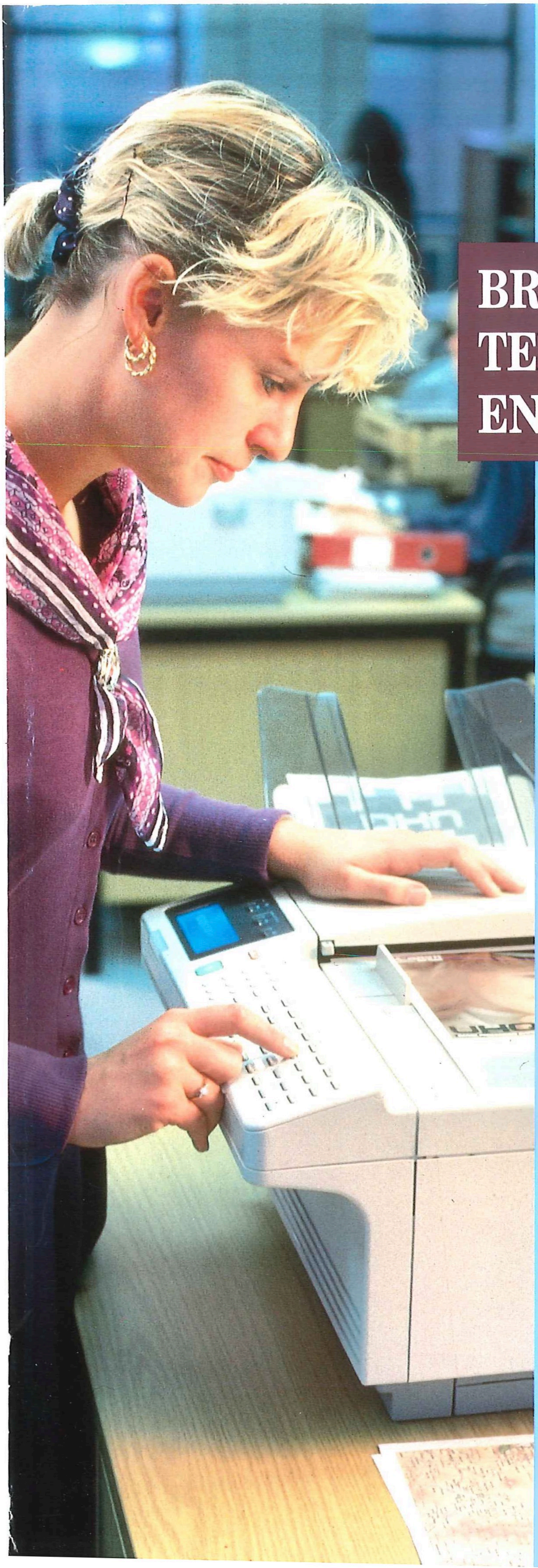


VOLUME 12 PART 2 JULY 1993

# BRITISH TELECOMMUNICATIONS ENGINEERING

*Account Management in BT*

*The Office You Wish You Had*

*Visual Services*

*New Road and Street Works Act*

**The Journal of The Institution of British Telecommunications Engineers**

# BRITISH TELECOMMUNICATIONS ENGINEERING


## Contents

VOL 12 ■ PART 2 ■ JULY 1993


**Guest Editorial: Managing Customer Relationships** 81
John Wheeler

**Account Management in BT** 82
Colin Banks

**Systems Engineering in BT's Account Management** 87
Colin Banks

**The Office You Wish You Had** 91
Peter Cochrane, Kim Fisher and Rob Taylor-Hendry

**Corporate Visual Services—An Overview** 97
Graham Mills and Ken Bayley

**ISDN in the Dealing Room** 102
John Crackett

**Assessment of Network Performance: The ISDN2 Performance Analyser** 110
Michael Parkin

**Standards for ISDN Architecture** 114
Trevor Kent

**New Road and Street Works Act** 122
Sid Russell and Peter Coleman

**Outsourcing Service and Information Technology Analysis—Part 1** 132
Tun Chun Nie and Ronald D. Hilton

**A New Cooperative Framework for European Public Network Operators** 141
Manuel Avendaño and Peter J. C. Hamelberg

**A Method for Compatible Coding of HDTV and TV** 146
Alan Quayle and Andy Humphreys


## *Regular Features*


**BT News** 154

**Industry News** 156

**Book Reviews** 158

**IBTE** 159

**Next Issue** 159

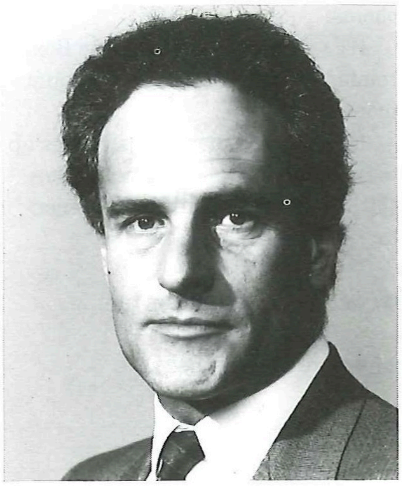
**Notes and Comments** 159

**IBTE Contacts** 160

GUEST EDITORIAL

*John Wheeler*

# Managing Customer Relationships



*Effective account management forms the cornerstone to any major company's sales and marketing plans*

Effective account management forms the cornerstone to any major company's sales and marketing plans, enabling rapid and confident understanding of solutions to business needs.

The environment in which BT's account management teams and its client companies operates can be summed up simply as dynamic.

In the communications marketplace, competition increases dramatically month after month, and BT is in contention with others for every bit of business. We have to fight for it and the battle gets tougher every year.

Likewise, our clients are under pressure from their own markets, and in some businesses, such as banking, from their own regulators; they are therefore forced to look harder at every investment decision they make.

Our account management teams strive to give clients an edge in the market-place, firstly by using flexible managed platforms that reduce clients' cost base, and secondly by providing capabilities via these managed platforms that enable clients to react quickly to their own market needs.

Taking an original proposal made to a client through to a successful solution involves all of BT's resources, with Global Account Management at the forefront of BT's virtual business team.

Several initiatives have been taken in account management over the past three years to change the BT sales force into the highly proactive and dynamic account and specialist engineering teams that are in place today.

The systems engineer client focus enables the account teams to sell innovative solutions to business needs based on an understanding of the technical capabilities of our products and services.

Systems engineers provide the professional engineering support so highly regarded by our clients and form the account teams backbone of engineering knowledge, talent and skill.

*John Wheeler*

**General Manager Retail and Finance**
BT Business Communications

*Colin Banks*

# Account Management in BT

*The role of telecommunications in the world today is evolving very rapidly, particularly in the technical area. To meet these increasing customer requirements, BT has set up account management teams, including account managers and systems engineers, backed up by a virtual account team—the crucial support elements available from the rest of BT.*

## Introduction

This article is the first in a series of articles on account management in BT, with special emphasis on the engineering aspects of the full and virtual account teams.

In this article, BT's account management process is outlined, and the framework within which the support engineers operate is described.

The key to the telecommunications market is to understand who customers are, and what they need or want. In general, a market segment identifies the group of customers whose needs can be satisfied by a particular product type, and a market sector is a group of customers with similar wants and needs. Within BT, for sales purposes, the appropriate groupings are served by sales sectors.

## Account Management

BT has an intention to account manage all of its customers. In the UK, the largest of these customers are account managed from within the appropriate UK Global sales sector.

BT's vision, *to become the most successful worldwide telecommunications group*, is reflected in the account teams that work with its major clients.

BT's mission statement (see Box) reinforces the importance of account management.

BT's account management lives up to the vision and mission, and takes the lead in applying the complementary BT values:

- we put our customers first
- we are professional
- we respect each other
- we work as one team
- we are committed to continuous improvement.

In addition, the account management team members have a requirement:

- to understand the client and the client's business.

**BT's Mission**

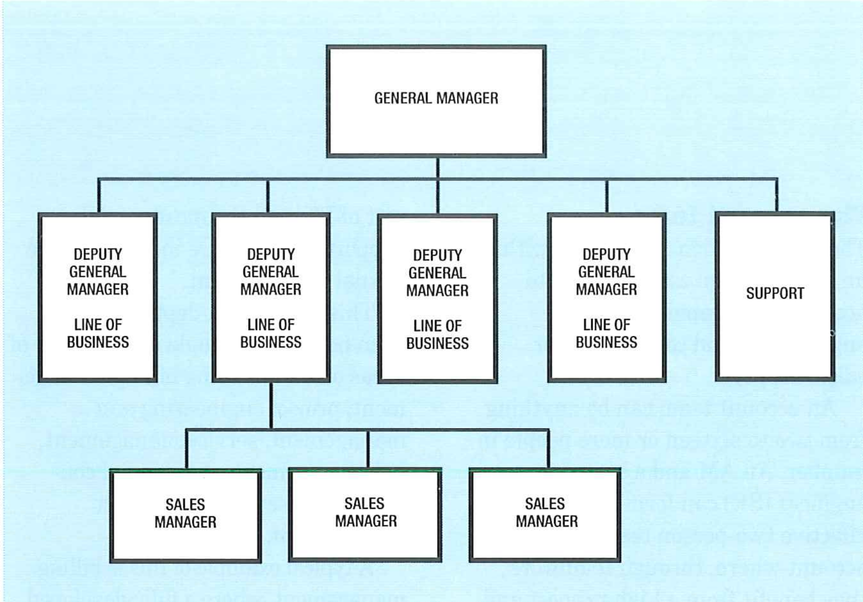
- To provide world-class telecommunications and information products and services
- To develop and exploit our networks at home and overseas—so that we can:

  meet the requirements of our customers

  sustain growth in the earnings of the group on behalf of our shareholders; and

  make a fitting contribution to the community in which we conduct our business.

Figure 1—Sales sector segmentation




## How BT Delivers its Account Management

To enable the vision, mission and values to be achieved, an operating framework is required.

### Account management sectors

In the late-1980s, the account management structure was organised into major business lines: Government National Accounts, Commercial, Retail and Finance, and Institutional Finance. At that time, smaller accounts were handled on a District basis by UK Sales Operations.

A direct result of this was an increased focus of skills within each sector on the needs of the clients within the sector.

Faced with the ever-increasing pace of change in business and product life cycle, the Retail and Finance Sector, lead by the General Manager John Wheeler, decided three years ago to further segment their market-place into lines of business (LOBs) in order to develop a better understanding of the clients' businesses and needs, specifically:

- to develop an increased depth of knowledge of the type of business, leading to a better understanding of business problems faced by the clients, and
- a focusing of the clients' demand for specialist products and services leading to improved products and services in the BT portfolio.

Figure 1 shows a typical sales sector following segmentation into LOBs.

Directly reporting to the General Manager are a number of Deputy General Managers, each having responsibility for a specific LOB.

The banking LOB, and retail LOB are good examples. The banking LOB comprises the four main clearing banks plus several of the leading smaller banks. The retail LOB comprises the major high street retail stores.

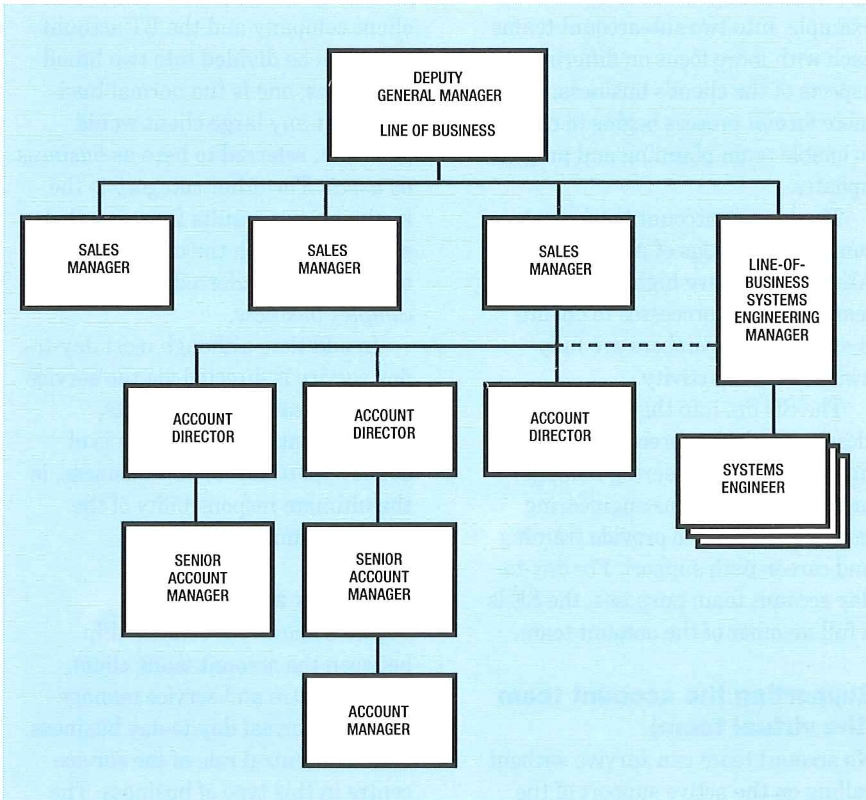
Reporting to the Deputy General Managers are a number of sales managers who have responsibility for defined subsets of the client accounts forming the LOB.

Figure 2 shows a typical LOB structure with its sales manager groups and account teams, and positions the systems-engineering teams.

There are typically between three and five sales manager groups per LOB, depending on the size and type of account, and from two to five account teams per sales manager group.

Each account team has an account owner who carries full responsibility for BT at the customer interface. This person may be an account director (AD) for the largest and most prestigious accounts (for example, a major bank), a senior account manager (SAM) or an account manager (AM).

Figure 2—Typical line-of-business structure



### The account team

The basic functions performed within an account team can be split into account management, systems engineering, and commercial (or sales) support.

An account team can be anything from two to sixteen or more people in number. An AM and a systems engineer (SE) can form a highly-effective two-person team on a small account where, through teamwork, they benefit from a high rapport and appear to the client to always be fully informed and in control of activity across the account. Team planning and progress updates can consist of brief daily head-to-head sessions in any appropriate venue, and can be completely informal but still achieve the objective. This small-team working can be extended to a three-person team, an example being adding an account executive as a junior account-management resource.

When the size of account demands an account team of more than three, the account team needs to develop a more formal structure; teams of four, five or six being sub-divided, for example, into two sub-account teams each with more focus on differing aspects of the client's business. A more formal process begins to emerge to enable team planning and progress updates.

The largest account teams have complex groupings of AMs, SEs, and AEs and will have highly-structured team planning processes to ensure that the team members are fully aware of team activity.

The SE fits into the team very closely, but has a direct engineering line to senior engineering management via the systems engineering managers (SEM) to provide training and career-path support. For day-to-day account team purposes, the SE is a full member of the account team.

### Supporting the account team (the virtual team)

No account team can survive without calling on the active support of the rest of BT, and the most crucial support elements are included in the virtual account team.

This provides in-depth support from nominated people in a number of areas of BT including billing management, project engineering and management, service management, bid management, commercial contracts, marketing and product management.

A typical example of this is billing management, where a fully-developed virtual-team element for a large account will consist of a tier 2 manager as the account billing representative, with either direct or matrix management responsibility for billing operations managers in private circuit billing, public switched telephone network billing, and other product areas.

The BT leadership programme 'Leading Through Teamwork' provides an excellent training example of how virtual teams can work together to achieve an objective, and is commended.

## Account Team in Operation

New business generated between a client company and the BT account team can be divided into two broad categories; one is the normal business that any large client would generate, referred to here as *business as usual*. The other category is the business that results from detailed consultancy with the client and the account team, referred to here as *complex business*.

In addition, although most day-to-day service is directed via the service centres or call-reception units, customer satisfaction, which is of equal importance to new business, is the ultimate responsibility of the account team.

### Business as usual

Figure 3 shows the relationship between the account team, client, service centre and service management for normal day-to-day business. Note the central role of the service centre in this type of business. The order placement cycle will be by electronic mail, fax or electronic data interchange direct from the client to the service centre, sometimes supported by a telephone enquiry. The account manager and systems engineer will be aware of the business being transacted and are available to assist in queries. The service-management element includes billing, planning and implementation of the orders.

### Complex business

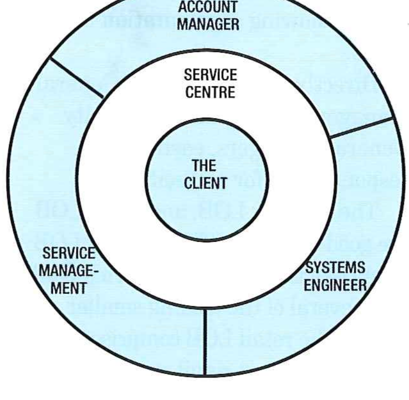
Figure 4 shows the relationships involved in complex business.

Here, from the centre out, the client's business needs (centre) are taken and developed by the AM and SE (first circle) into a proposal after consulting with the essential support elements (third circle) with support from marketing and product line. Note the presence of billing management at this stage—billing is a complex matter of considerable importance that has to be involved at the earliest point possible in contracting a business proposition.

In complex business, the business need may develop from a direct enquiry from the client, or it may result from the account team's knowledge of the client's business, leading to a proposition from the account team.

Once a need is identified and agreed, there then develops a period of exchange of views and ideas that can vary from days to years depending on the complexity of the proposi-

*Figure 3—Business as usual*



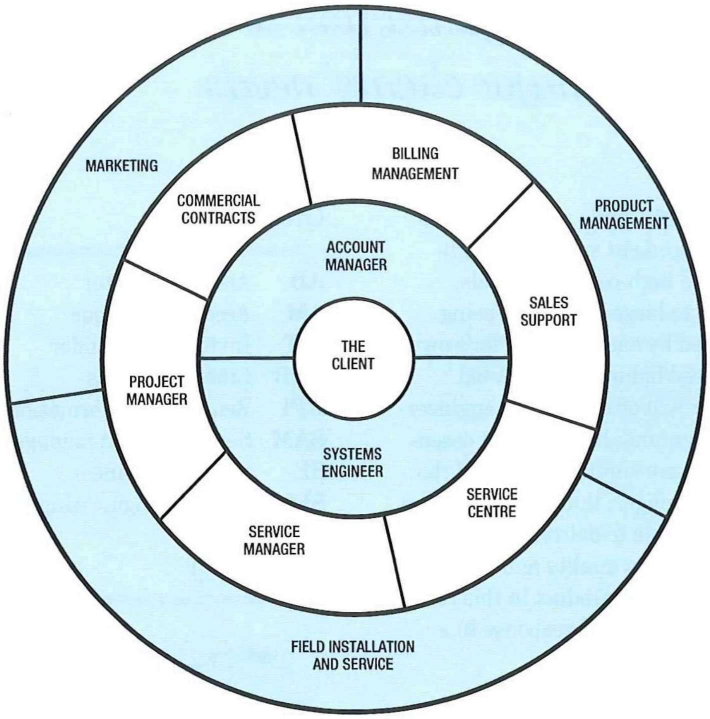



*Figure 4—Complex business*

The account team will have been prepared in advance for the arrival of the ITT and will have a bid team formed ready to create the response.

***The bid team***
A full bid team can involve all of the functions indicated in Figure 4, led by a bid manager, who may be a specialist bid manager for a large-scale bid, or the AM or SE for a smaller bid.

They will create a bid plan which allocates responsibilities for discrete elements of the bid to individuals or groups of individuals, including time-scales and guidance for continuity of the bid from section to section.

Full support from within the business for a bid is confirmed by the bid sign-off procedure which obtains signed concurrence from four separate areas of the business (Commercial Contracts, Finance, Sales and Implementation) for the response. The responsibility for obtaining this sign off lies with the bid manager.

tion, and can be on an informal or formal basis. Government accounts, such as the Civil Service, because of their complexity, tend to be on the most formal process-driven basis and have the longest development periods.

A formalised process will contain recognisable stages.

***Client presentations***
A client may request presentations on products, services or complete solutions. These presentations could range from a simple one hour meeting to a series of events that can include visits to BT sites such as BT Laboratories at Martlesham Heath. The client may then use the information gleaned from these presentations (and from other suppliers) to put together a formal request for information (RFI).

***Request for information***
An RFI generally follows the recognition by a client that there is a business need to be solved, and that more than one supplier can offer a solution. These are more often seen in larger accounts where clients have their own technical departments to evaluate solutions, and are sometimes used to obtain general information about products before a specific need is known.

An RFI is treated in the same way as a bid, produced to tight time-scales, fully supported within the business and controlled by ISO 9001 quality standards.

Most of the supporting virtual account team shown in Figure 4 will be made aware of the prospect at this stage, and many will contribute to the RFI response.

On receipt of several RFI responses from different suppliers, a client will have the most up-to-date library of competitive leading-edge products and services available. The client may now decide on the type of solution appropriate for its business need and, based on the RFI responses, will construct an invitation to tender (ITT).

***The invitation to tender***
The appearance of an ITT indicates to the account team that the client has a serious intent to buy, and that there is more than one supplier with the capability to supply. (ITTs are not generally used in a sole-supplier situation.)

An ITT can vary from 20 pages to a volume, and ITT responses are generally five or more times the thickness of the ITT!

Areas covered include commercial contract terms, health and safety, technical specification, systems management, overall systems performance standards, site specifics (for example; access limitations), costs, warranty, environmental requirements, quality, and many more.

## Engineering Aspects of the Full and Virtual Account Team

### Role of the systems engineering manager in account management

The role of the SEM is broadly similar whether at the LOB level or the sales manager level; that is:

- to ensure that adequate SE resource is available to the sales managers across the accounts;
- to manage the SEs, including training and career development;
- to ensure the technical excellence of proposals within the group, by monitoring of the standards of proposals, ensuring that SEs have the skill base to handle sales prospects, and by gaining support from within BT for sales proposals; and

*The sales account-management organisation in BT has been structured to meet major clients' needs*

- to liaise with product lines to ensure current and future product fit with client business requirements.

### Role of the account systems engineer

The role of the account SE is:

- to qualify and sell, together with the account manager, engineering solutions ;

- to identify and develop new opportunities with the account managers for revenue-generating systems and network sales; and

- to prepare proposals covering the systems elements of BT solutions to client requirements.

### Role of the specialist systems engineer

The role of the specialist SE is:

- to provide specialist support to account team SEs on nominated products and services; and

- to produce and support client facing presentations on nominated products and services.

### Role of the project manager

Account-management teams do not include project managers, project management being provided from elsewhere within BT; the main source being the national and regional project teams.

The subject of project management is sufficient to fill a book, suffice it to say that in account-management terms, the project manager takes the solution through from bid to implementation handover, and is the key to customer satisfaction with the project by ensuring delivery to time, to quality and to cost.

### Role of the bid manager

The bid manager is often a nominated member of the account team, but, as the scale and complexity of a bid increases, the point is reached where a full-time bid manager is required.

The customer skills centre provides bid-management support to high-value and high-complexity bids, medium to large value bids being supported by each sales sector's own specialised bid managers. A bid manager will often have an engineering background, but the most essential skills are similar to those of the project manager; that is, to conduct a team of people to deliver a product to cost, to time, to quality and to the right place. The product in this case being a winning bid response to a client.

## Conclusion

The sales account-management organisation in BT has been structured to meet major clients' needs through vertical business sectors and lines of business. This enables a greater focus on market sectors and development of BT products and services that address specific market-segment needs.

Within the BT account-management teams, the increased emphasis on market segmentation is focused through the account manager and systems engineer to develop solutions to a client's needs.

Development and implementation of these solutions relies on the virtual account team giving full support through the BT values, with teamworking being the essential ingredient.

## *Glossary*

| | |
|---|---|
| **AD** | Account director |
| **AM** | Account manager |
| **ITT** | Invitation to tender |
| **LOB** | Line of business |
| **RFI** | Request for information |
| **SAM** | Senior account manager |
| **SE** | Systems engineer |
| **SEM** | Systems engineering manager |

## *Biography*

**Colin Banks**
BT Business Communications

Colin Banks joined the then British Post Office in 1963 as a Trainee Technician (Apprentice) in London North Telephone Area. In 1969, he joined the Strowger local exchange maintenance division and progressed to managing local Strowger and TXE4 exchanges. In 1981, he became responsible for the area Management Services Unit, including manpower planning for the local exchange modernisation programme, and area computing services. In 1984, Colin became part of the team that created National Networks (later to evolve into Worldwide Networks), and ran transmission and trunk switching operations for Northern London District until 1988, when he moved into BT National Account Management as a level 3 senior project manager for the Lloyds Bank account team. In 1991, he moved to his current role as systems engineering manager, initially for the NatWest Bank account team, and then for the London-based banking LOB. He is a member of the British Institute of Management.

*Colin Banks*

# Systems Engineering in BT's Account Management

*The systems-engineering function in account management not only forms the backbone of engineering knowledge and skills in the account team, but the systems engineer is often the main point of contact with the client. The range of skills and depth of knowledge required by the systems engineer are thus many and varied.*

## Introduction

This article is the second of a series of articles on account management in BT, with special emphasis on engineering aspects of the full and virtual account team.

In this article, the part played by BT's support engineers in BT's account management is outlined, together with qualities required to carry out this demanding role.

In the Guest Editorial to this issue of the *Journal,* John Wheeler, General Manager of the Retail and Finance Sector, refers to the dramatic increase in competition month after month, and the dynamic environment in which both BT and its client companies now operate.

These changes place a heavy demand on the systems-engineering functions of account management which form the backbone of engineering knowledge and skills throughout this dynamic period, and likewise places demands on the specialist support engineers in the customer skills centre and the sales sectors.

The systems-engineering role in account management can be subdivided into three main areas:

- the systems engineering manager (SEM),
- the systems engineer (SE), and
- the specialist SE.

The SEM works with sales managers to manage groups of SEs in their account team environment, or groups of specialist support SEs.

The SE works within account teams and acts as a direct engineering interface to the client.

The specialist SE acts in a support role to the account SE and, as the name suggests, supplies specialist support for a focused range of products and services.

All three have crucial roles to play within, and in support of, account teams. These roles are defined and understood, but when teamworking, the SE and SEM will often undertake very similar roles to achieve the end result.

## Role of the Systems Engineering Manager in Account Management

The role of the SEM in account management is:

- to manage the SEs, including training and career development;
- to ensure that adequate SE resource is available to the sales manager across the accounts;
- to ensure the technical excellence of proposals within the group, by monitoring of the standards of proposals, ensuring that SEs have the skill base to handle sales prospects, and by gaining support from within BT for sales proposals; and
- to liaise with product lines to ensure current and future product fit with client business requirements.

The SEM generally manages a group of four to six account-based SEs within a sales group as well as having some direct account responsibility.

SEMs spend typically 50% of their time on staff management and

*the SE's role is to translate the product technicalities into the practicalities of the client's business needs*

training, and 50% on direct account-based SE work.

Staff management is predominantly via the BT 'manager as leader and coach' (MLC), a technique that applies to all of the BT sales force.

MLC is a training programme that all BT sales staff are involved in, including SEs. It is based on monthly 'accompanied visits' where the SEM accompanies the SEs on calls (target of one accompanied call per month) with each call having a pre-visit briefing and a post-visit debriefing.

Immediately following the accompanied visit, the SEM and SE discuss the visit openly and honestly, highlighting areas where improvements could have been made, and agreeing actions to improve future performance.

The accompanied visit also leads to building personal development plans, which form a crucial element of MLC, linking together coaching with mentoring, formal training and longer-term development and career planning.

## Role of the Systems Engineer

The role of the SE is:

- to qualify and sell engineering solutions together with the account manager;
- to identify and develop new opportunities with the account manager for revenue-generating systems and network sales; and
- to prepare proposals covering the systems elements of BT solutions to client requirements.

The account-team-based SE provides the client focus into BT for engineering issues and strikes a balance between the market-place demands on BT's customary ways of operating and the realities of deliverables, ranging from interpreting major visionary concepts through to the finalisation of detailed proposals.

An example of this is the introduction of complex new products and services such as managed platforms (for example, FeatureNet 5000) where the SE's role is to translate the product technicalities into the practicalities of the client's business needs, such as the particular needs of a client's typical operational site.

The SE works from a client knowledge base which can range from the physical location of the equipment room at a client's site, to the routing of cables into the site, and from the networking protocols used by the client to the network topology of major voice and data networks.

## Role of the Specialist Systems Engineer

The role of the specialist SE is:

- to provide specialist support to account team SEs on nominated products and services; and
- to produce and present client-facing presentations on nominated products and services.

The specialist systems engineer complements the account team by providing essential highly-focused product-specific technical support across the account teams.

An example of this is the expert support provided by specialist SEs in designing Meridian Call Centres, calling on a knowledge of the Meridian product in all its forms, its interfaces to host computers and use in a call-centre environment, and a detailed understanding of the call-centre concept (one of the most dynamic growth areas of modern business).

## Typical Systems Engineer's Engineering Background

Engineers can enter account management as graduate entrants or by transfer within BT, in which case they have a strong track record of experience, usually in more than one aspect of BT engineering.

The NAMGRAD scheme provides yet another path into systems engineering. Here the SE has followed a structured development programme which culminates in full SE status.

Often, sponsored BT engineers enter the NAMGRAD programme after successfully completing degree-level academic training.

A typical SE will have come from transmission, private automatic branch exchange (PABX) or network areas of the company, from installation, planning or service arms, and many have been project managers at some time. Other sources of SEs range across the whole of BT; for example, BT Laboratories at Martlesham Heath.

It is unusual, but not unknown, for BT to recruit systems engineers externally.

### Skill set

The most critical skills that an account-based SE has to have are additional to technical skills—they are the skills of understanding people, needs, motivation, and an understanding of how companies and large organisations operate, especially intra-client company communications.

Equally, the SE must have an understanding of the dynamics of the account team within which he/she works .

The SE has to be able to appreciate the implications of account-team activity in one part of a client company on other areas of that company. For example, what will the reaction be of a client company purchasing department if it is the only department not to be informed of a major BT tariff revision? Particularly if they are about to place a large contract with BT!

Above all, the SE has to be able to represent BT at all levels in a client company, be presentable, with a good personality, good communication skills, able to go from a technical discussion with an analyst through to a senior manager discussing, for

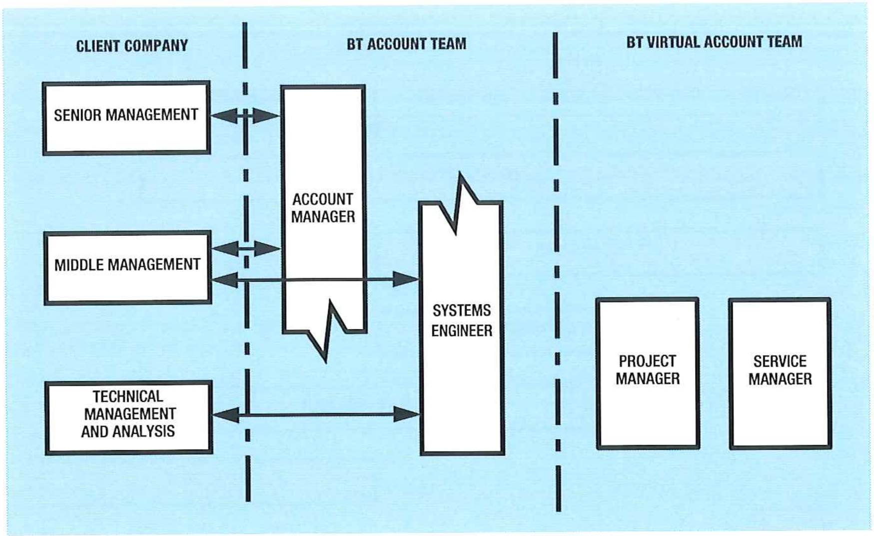



*Figure 1—Contact levels*

example, cash flow and the impact of exchange-rate changes.

The account management SE has to have a broad range of general technical skills to be able to understand and interpret the client's business or technical requirements. These technical skills will be deeper in areas of immediate application in the client's business.

For example, an SE may be dealing on a day-to-day basis with upgrade requests for existing PABX equipment and interconnecting networks. The upgrade information from the client will be technically biased and detailed, and needs to be understood by the SE at the same level.

In parallel with this work, the SE may be called upon to work with the account manager to build a design for a Meridian-based call centre. This requires knowledge of marketing, specifically telemarketing, through to call-queuing handling and from cable terminations on building distribution frames through to the frame structure of messages passing between the Meridian and a host computer. Client contact by the SE could well be technical in nature, but could equally be with an operational management team of prospective users of the call centre who have little technical knowledge.

When pricing a complex business solution, the SE needs to understand fixed and variable costs, profit, average manhours per job, manhour rates, discounting, etc.

Delivery to time-scales requires an understanding of the order-handling process, planners time, suppliers production and delivery time-scales, field installation and commissioning times, etc.

Added to this is a need for a general knowledge of the BT product range, the regulatory conditions within which BT trades and the commercial conditions that form the framework of the business.

## Systems Engineer in the Account Team

Each account team has its account strategies and plans for sales and service, formed from planning and review sessions, and operates in a coordinated way to implement its plans.

The account team SE forms an integral part of the team, joins in the debates on development and implementation of these plans and normally operates in close relationship with an account manager (AM) or senior account manager (SAM). These are the people from whom the SE takes his day-to-day operational and sales direction.

The engineering line of career progression and training is maintained by direct line management from the SEM.

### Systems engineer in contact with the client

The account SE represents BT to the client (as do all BT staff), but is seen by the client as part of an account team that has a special relationship and responsibility for the client's business with BT. In a small account team, the SE may, in fact, be the only member of the account team that some parts of the client's company see regularly.

The SE, therefore, needs to be a good ambassador of BT to the client and also needs to be the client's ambassador into BT, representing the client's special needs for products and services.

The SE needs to be presentable, articulate, able to engage in conversation on any subject, whether it is the client company's fortunes in the stock market or the latest software level of a product.

Contact within the client company has to have a structure to enable the account team to work without conflict and confusion. A simple general plan is shown as Figure 1, in which the account SE and AM map their contact activities against management levels in an account. The project manager and service manager are also shown to position their relative contact levels.

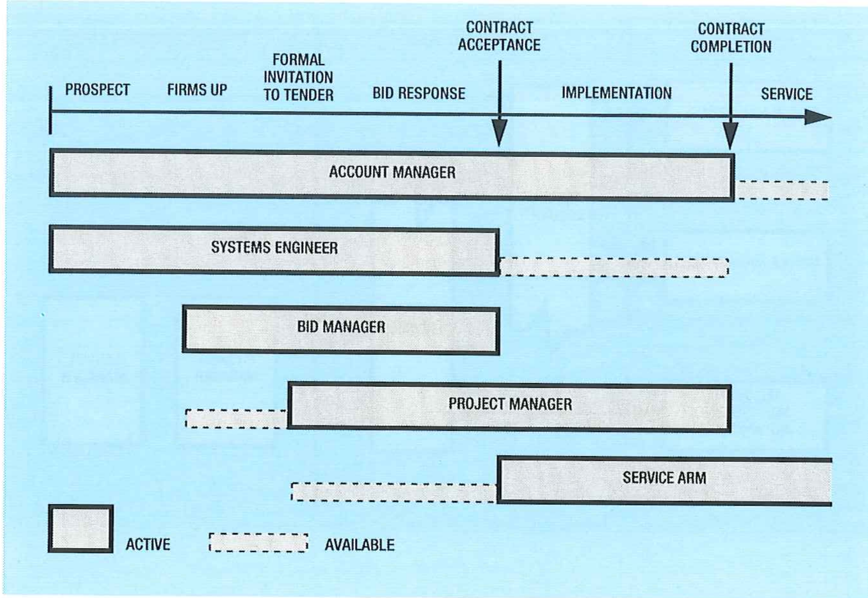
A live contact plan would specify names of clients or functional groups as appropriate to the account, and would be known and understood by all team members. Critical to the contact plan is the theme of ownership in which an account team member (the SE for example) will own a range of client contacts, and any other team member who meets those contacts will report back to the SE on issues raised and discussed. This simple principle allows close control and tracking of activities, and becomes increasingly important as the size and complexity of a client account increases.

### Systems engineer in a bid situation

The SE in an account team will have early warning of a bid situation, and may well have created the conditions for the bid to mature.

Typically, the SE and/or the AM will have seen a need for a solution to a client's business problem during normal client contact meetings and proposed a solution or range of solutions.

*Figure 2—Progress of a typical sucessful sale*




The solutions will have been created by the SE working with the AM either directly from his knowledge of the client and BT products and services, or he may have called on one or more specialist support groups (SE or product line) to assist him. For a complex business need there may well have been several problem-solving meetings called by the account team including 'brainstorming' to arrive at a range of potential solutions.

These solutions will then have been discussed in detail at a series of client presentations.

Depending on the type of solutions being proposed, the account SE may have made a formal presentation to the client's technical representative, or may have called on a specialist SE or product manager to do so, in which case the account SE will have hosted the presentation.

Often, such technical presentations are followed by a request for information (RFI) in which the client formally requests more detailed information specifically tailored to the business solution being proposed. This is responded to by the account team with an *RFI response*, which is a formal document within the ISO 9001 quality process. The SE takes a major role in a response to an RFI, being the team member who can both understand the technical proposition and, with the AM, interpret the client's needs.

When the client produces a formal invitation to tender (ITT), the SE or AM will report this back to the account team and a bid team will be formed in preparation for the arrival of the ITT. The SE will be a vital member of this team. The SE may well perform more than the SE role in the bid team for a small bid, typically acting as bid manager and bid producer as well as composing the technical response sections.

Figure 2 shows the relative activities of AM, SE, bid manager and project manager as client's business need is progressed through to a successful sale.

The account manager is the bid owner throughout the life cycle of the bid, and has overall responsibility for all aspects of the bid.

The SE is responsible for the technical aspects of the bid up to contract acceptance, and is then available for input and clarification during the implementation phase.

The bid manager is responsible for the bid until acceptance of the bid by the client.

The project manager is identified and becomes part of the bid team at the earliest possible opportunity, becoming an active participant on receipt of the ITT, but does not assume full project responsibility until contract acceptance, after which he is fully responsible for implementation.

The service arm is made aware of the prospect at an early stage so that any special service processes can be put in place ready for the contract start. At contract completion, the service arm then becomes fully active.

Throughout this bid process, the account SE has a high-profile role as the focus of knowledge of the client's technical environment, and is constantly in demand from the bid team, and from the project manager during the implementation phase.

## Conclusion

The account-based SE is very much a team player, forming the backbone of the account team during times of rapid change.

The SE's skill set is very wide, usually based on long experience of BT, its products and services and BT as a company with its vast resources. The most important skills for an account SE are as a representative of BT to the client, and the ability to understand the client's business.

An essential complement to the account SE is the specialist SE, performing the role of technical specialist in ranges of products and services. Given that the account SE has to be able to interpret and propose a solution to the business need, then the specialist SE is the person who can turn that proposal into a substantial solution.

## Glossary

**AM** Account manager
**ITT** Invitation to tender
**MLC** Manage as leader and coach
**PABX** Private automatic branch exchange
**RFI** Request for information
**SAM** Senior account manager
**SE** Systems engineer
**SEM** Systems engineering manager

Peter Cochrane, Kim Fisher, Rob Taylor-Hendry

# The Office You Wish You Had

*In many respects, the office has changed little over the past 200 years. The introduction of the telephone, copier, fax and computer has only served to speed up and proliferate the basic processes associated with their use. We are now faced with an increasingly complex environment that requires fundamental changes to humanise the processes. This article addresses some of the interface issues that now appear to have near-term solutions.*

## Prologue

Life has evolved over the last 600 million years with the human race optimising its interface with the natural environment in the last 100 thousand or so. This evolutionary process has equipped us for an environment consisting of modest size entities moving at reasonable speed in reasonable time frames. In contrast, the evolution of technology during the past 60 years has placed us in a foreign environment with massive and minute entities moving at incredible speed in very short time frames with very little or no perceptible delay between events. That is, the electronic evolution has now outstripped the rate of our biological evolution to cope with change. Moreover, our interface with technology has generally been designed for the convenience of the technology and is not intuitive or biologically matched to our abilities. If we are to change the office and the working environment significantly in the future, then these issues have to be addressed and the interface has to have a human orientation.

Computer and communications technologies now look ripe for the introduction of some radical and long overdue change. Much of the technology and know-how is available (in abundance) to revolutionise the office, the home and the place of work far beyond the evident results of incrementalism we currently enjoy. In many respects, we might now therefore consider the modern office to be an unnatural, and even hostile, environment for most humans. We currently suffer interfaces and conditions that are not convenient, user friendly, or conducive to efficient and pleasant operation. This applies for the interfaces between humans and between humans and machines. This is not however, in our view, a necessary condition and perhaps, more importantly, it is not sustainable in the long term. The question is: what is sustainable, and what happens next?

Addressing this question and the likely solutions to the preceding problems presents the main theme of this article. We thus explore a series of proposals for potential future office environments. These follow an underlying holistic approach to the integration of existing and new technologies to create a new IT environment. The approach is integrated, intuitive and responsive to human needs, and places both the user and the tasks/work at the central focus.

## Some Wishes

I wish:

- my phone was always with me;
- my desk wasn't covered with machines and cables;
- I could communicate with people whenever I wished, and they could communicate with me whenever they wished;
- I could get rid of much of the paper with which I'm faced;
- I didn't have to travel so much;
- I could be in two places at once;
- my PC wasn't so unresponsive and unfriendly;
- my PC could simultaneously display multiple (and full) electronic pages;
- my PC screen could offer some of the features afforded by paper; for example, be flat and horizontal when required;

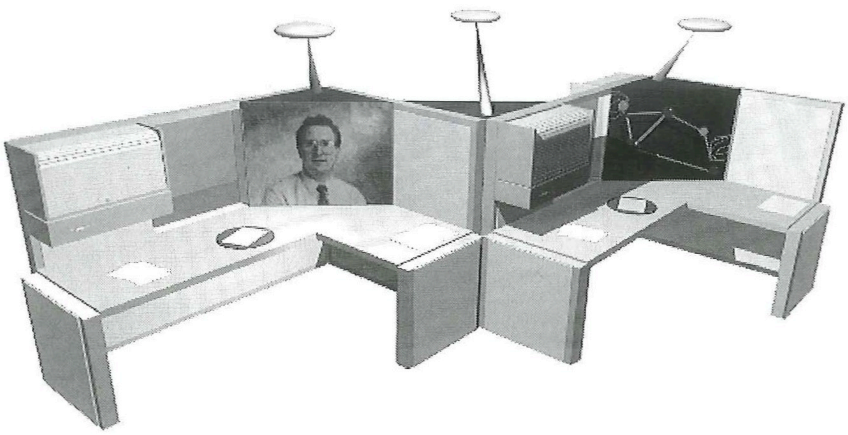


*Figure 1—Future desk*

- I could talk to my PC and it to me;
- my diary and daily schedule were automatically kept up-to-date;
- I had an easily insertable and retrievable database of all my contacts;
- my mail was electronically sorted, summarised, prioritised and filed;
- information could be retrieved with only a partial definition of what was sought;
- I could voice annotate documents;
- I had all the power of my office wherever I happened to be;
- it didn't take 3 months to move office and restore full IT facilities;
- teleconferencing was not so limited and lacking in realism and facilities.

What are the critical barriers to meeting this wish list? Some would be:

- limited physical flexibility and communication bandwidth with current office wiring;
- constraints of cordlessness and portability; for example, size, weight, power unit life and channel capacity;
- information copy on paper cannot be reused easily;
- information overload, posing difficulties with categorisation, filing and retrieval;
- inadequate and inhuman interfaces;
- multiple devices which don't easily interface or integrate;
- storage and processing power available only as hardware.

So here is a proposal for a method of breaking down these barriers in the office environment centred on the realisation of a 'future desk'. In Figure 1, the desk is realised with currently available technology integrated to satisfy our known and defined requirements, but with the inclusion of a set of human-orientated interfaces.

Specific features of the desk include:

- optical communication that is cordless and has a large bandwidth;
- all the equipment used is built in, not on, the desk with cordless peripherals and an active surface for document display;
- multi-standard input and output interfaces;
- intelligent non-intrusive human interfaces;
- software filing, summarising, and correlating;
- intuitive and ergonomic control systems;
- built-in recognisers for 'hot desking', with a secure data environment;
- teleconferencing with human-scale interactive images;
- hi-fi acoustics; and
- voice input/output and command.

Let us look at some of these features in detail in the sections that follow.

## Office Wiring and Optical Wireless

One of the major limitations of present-day office design and realisation is the necessity for hard-wired desks. Even with the exciting optical-fibre technology developments, there still remains an underlying problem with the cabled office: getting cable to where you want it, then following users as they move office. With the increasing demands for more communication and greater flexibility in office working, this is likely to become even more problematic in the future. The speed of market- and technology-induced change implies regular reorganisations and movement of staff and operations in most sectors of the business community. It is not uncommon to experience a delay of weeks, sometimes months, before all electronic back-up systems are re-terminated at a relocated desk.

Optical wireless is a technique analogous to radio that affords an important means of short range, diffuse and line-of-sight fixed and mobile communications without the regulatory or technical restrictions of radio alternatives. Data can be omnidirectionally radiated from a ceiling, desk or body-mounted antenna and transceiver (Figure 2). Transceivers using holographic dispersers can illuminate very well defined cells so that different data domains can be accurately positioned and addressed within the office

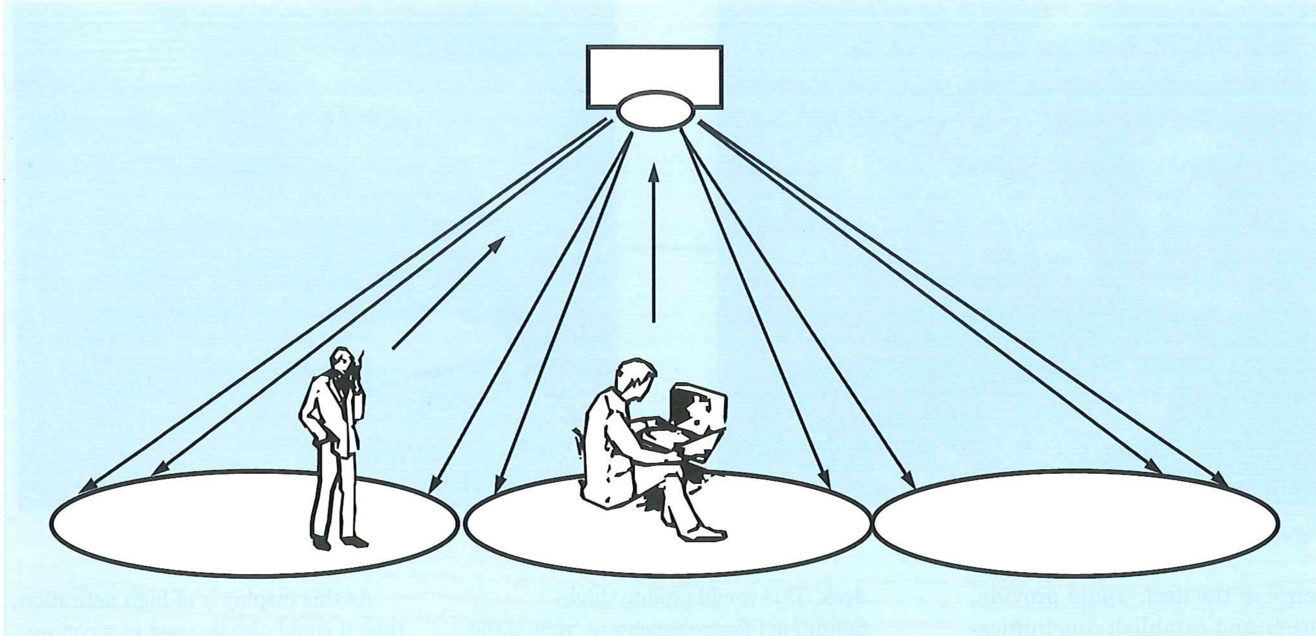


*Figure 2—Optical wireless in the office—ceiling satellite*

environment (Figure 3). The bandwidth of the communication channel is potentially as broad as cable-based optical-fibre systems, thereby allowing broadband multi-channel services. The use of a lightweight headset fitted with optical transceiver, microphone and earpiece can afford cordless communication (Figure 4). Furthermore, voice recognition elements would allow direct voice input/output with computer and communication systems. With intelligence built into the cellular optical wireless system, the headset could be tracked and automatic location and activity systems used to produce 'who,where and when' activity databases. Combining voice recognition and the location facility would provide a secure method of 'hot desk' operation anywhere in an office. Talk to any desk and it could check your identity and configure to your own personal definition using the broadband optical communication to access your virtual desk's facilities.

An office equipped with optical wireless would have an omnipresent optical ether so that people and their desks could be mobile . People and equipment would be free to roam within a building with no more data, printer, fax or telephone cables—only cable for desk power would be required.

## The Desk

Today, desks are passive objects on which we stack, and in which we store, things. Technology has made them a mass of wires, equipment boxes, keyboards, mice and telephones; none of which easily work with each other and all with their own proprietary interfaces. The wiring alone causes configuration difficulties while the integration of diverse software and hardware is rapidly approaching nightmare proportions. One solution is an active desk with:

- a partitioned structure used to house equipment;
- an inductive working surface to provide battery charging and communication to cordless peripherals;
- ergonomically built-in multi-purpose displays and input devices;
- radically new user interface such as 'hands in the screen' (Figure 5) and eye plus voice tracking; and
- all interfaced via a built-in optical backplane.

Multi-vendor devices could be added (like shelves in a racking system) via equipment slots built into the structure of the desk. This would mean a device such as a CD WORM unit could be purchased and just dropped into a slot. Intelli-

*Figure 4—Optical headset*

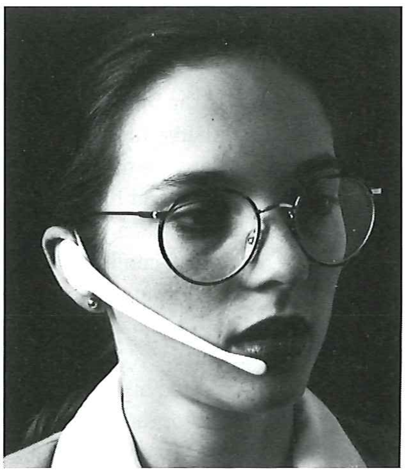
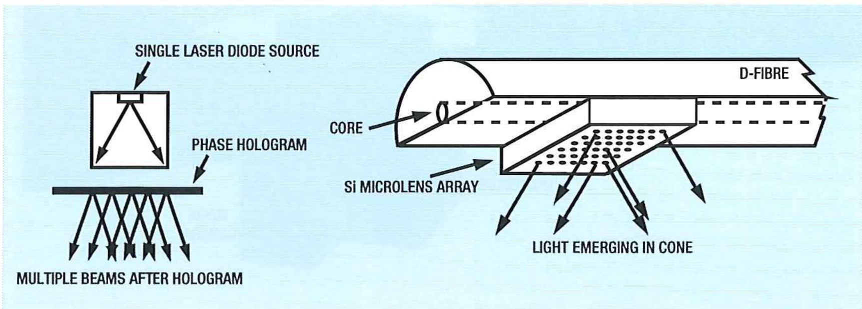


*Figure 3—Holographic lensing and micro-cellular*



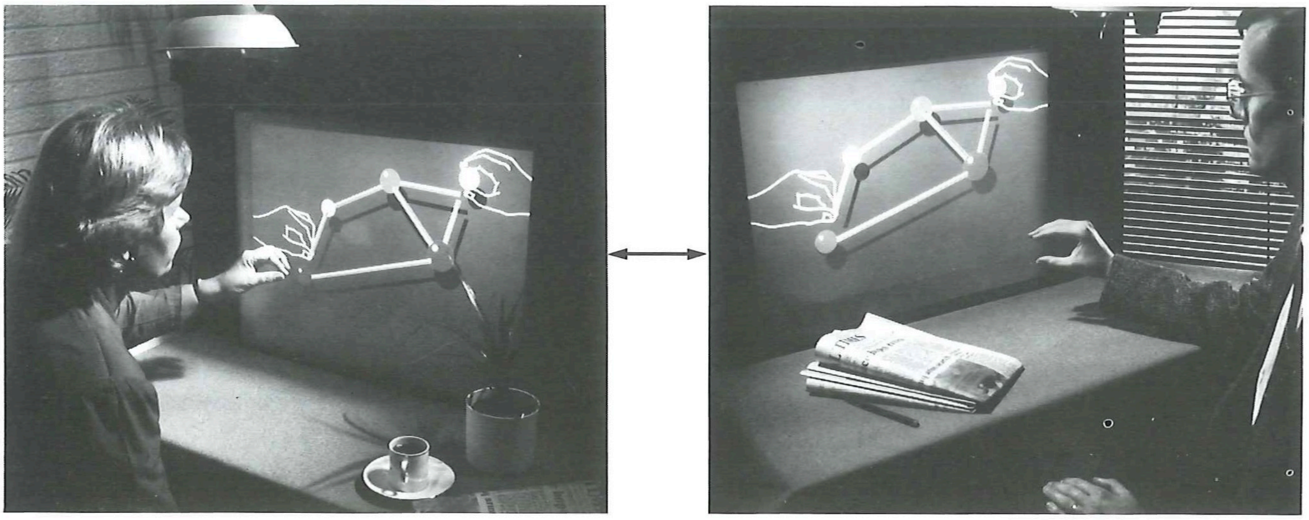


*Figure 5—Hands in the screen*

gence in the desk would provide power and establish communication, and integrate it into the computer workspace as well as displaying its controls on any desired display.

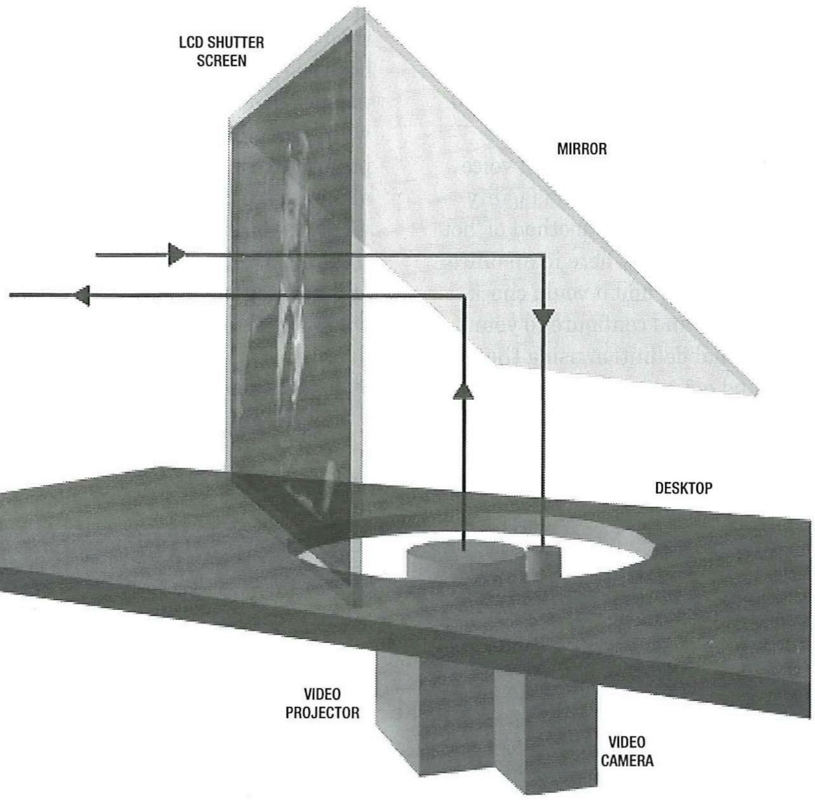
Inductive loops printed below the surface of the desk (like a car's heated rear window) could charge anything placed on its surface, as well as establishing a communication channel. A laptop or active organiser, for example, placed on the desk could be trickle charged at the same time as communicating with the desk, allowing the full processing power of the desk to be instantly available without any physical connections. The use of optical wireless could facilitate the use of cordless equivalents to the mouse and keyboard.

## Multiple-Purpose Displays

Video conferencing has the ability to reduce radically the need for people to travel and can also deliver a new team-working media for geographically dispersed organisations. The constrained bandwidth available today for this human interface currently produces visual anomalies in the perception of the images and is detrimental to realising its full potential. A different type of interface is proposed to improve and humanise the limiting aspects of videoconferencing. An image can be projected which conveys an impression of presence with the use of telepresence hardware.

A large rear-projected high-definition TV (HDTV) monitor could be ergonomically placed (Figure 6) in the desk. This would produce high-definition life-size images in front of the user (in a natural face-to-face mode). A video camera could be aligned to be looking directly at the user through the screen by means of a liquid crystal display (LCD) shutter as the screen material. This would enable a human-sized image of your conversant with eye-to-eye contact and gaze awareness. Because of the large size of display, the peripheral vision would be partially filled and create a feeling of 'being there' rather than watching a picture.

*Figure 6—HDTV back projection*




As this display is of high definition, then it could also be used as a computer monitor and in many applications allow the mixing of videoconferencing and computer-generated data.

By using an infra-red-emitting pen, the screen can also be turned into an electronic whiteboard (Figure 7) via infra-red sensing in the camera driving the cursor controls of the computer. This allows multiple videoconferencing participants to work together in the same electronic media space in real time. People sitting at

desks thousands of miles apart come together in an electronic media to realise real-time team-working.

## Hands in the Screen and Voice Control

The preceding user interface has been realised by an integration of currently available technologies and working practices. However, the addition of an overhead camera, scanning the desk's surface, and producing a positional image of the user's hand (or three-dimensional radio-frequency positioning sensors worn on the finger) allows the realisation of an economic 'hands-in-the-screen' image (Figure 5). This direct hand control and manipulation of screen objects can be linked to the function of the computer and peripheral equipment. No keyboard is necessary; just highlight the text, grab-it and put it where it is wanted.

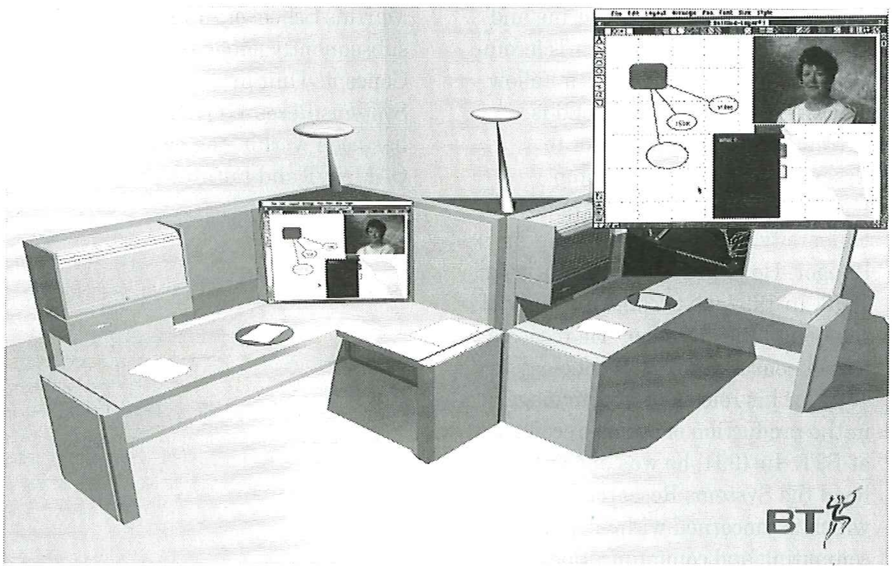
A 'hands in screen interface' allows modelling and manipulation of virtual objects and text. Furthermore, objects and text can be placed in the medium viewed through the screen and directed by a combination of voice and hands. To add some text to a document, just speak the additional text, grab it, and put it where you want.

## Emotional Icons

To enhance the lifelike and intuitive nature of the visual interface, three-dimensional technology is being introduced to add a depth of vision, dimension, reality, and personality to the environment. Computer display objects (icons) representing, and used for, functional control are being humanised to react emotionally and give heuristic guidance during interactive sessions with movement, stance, colour and audio to convey reactions. For example: an icon might try to avoid your hand if the action was questionable, such as the printing of a document where the spelling had not been checked: or become defensive if you are about to initiate a potentially damaging action such as the deletion of a file. Such icons would reduce the probability of operator error. Other opportunities would arise to cater for ambivalence by the operator, who might say 'phone granny'. The display could show both grandmothers' names and a dot could dither impatiently between the two. A 'Granny Fisher' statement would then prompt the machine to dial the pertinent number.

Frequently-used functions could be represented by large and easily activated icons, while less frequently used controls gradually migrate to smaller size and lower control layers.

*Figure 7—Future desk in electronic whiteboard mode*



## Electronic Post-It Screen

To ensure that the main working display is not crowded with buttons, icons and electronic messages, another separate yet simple display with a touch-sensitive surface or voice activation can be appropriately positioned. This can be used for telephone directory listings, 'post it' pads and keys that are software configurable . For example, the post-it screen would enable an up-to-date electronic directory to be displayed and a telephone call established whilst still being part of a video team working session on the main high-definition screen. The post-it screen would also act as the control panel for all equipment that is installed in the desk—no more front panels on boxes you cannot reach.

## Documents, Copy and Retrieval

The paperless office does not exist and might be perceived to be less likely with time as more technology is introduced that demands more copies. Forecasts suggest the demands are non-sustainable in the long term and we have to reverse the trend and halt the growth in paper proliferation.

It is no longer necessary to distribute documents. A bar code could be assigned to each document at creation, together with a distribution list. The 'desk' of everyone listed is then 'advised' that the document is available for access, and further codes then added to the original document indicating when, and by whom, the document was accessed, and whether hard copy was taken or comments added.

Today, the identity of documents needing to be retrieved must be definitive. However, if the voice of the desk user, and any visitors, were recognised by the desk, such information could be associated in the code assigned to any other activity on the desk, such as the receipt of a document. Later, it might be possible to retrieve the document, or at least a

*All of the technology described is either available or currently under development.*

short list of possibilities, by requesting 'the paper that arrived during the meeting with Rob, last Wednesday'.

As we move to a multimedia environment, then the ability to add colour, moving images, sound and interaction to documents will lead to paper being a less-informative medium. Electronic mail will then include video sequences, active directories and databases in a form that match your desk's personal 'sifter' and organiser.

## Memory and Processing

The many facilities outlined, together with the anticipated amounts of data required, are going to place heavy demands on memory and processing power. However, with the cost of both dropping by an order of magnitude over the last 5 years, and the trend looking set to continue, then the technology should be within the reach of most offices within the next decade.

In order to reduce the memory required, a process of (Hebbian) data decay is being investigated. Documents could be reduced in data content with time as their perceived importance diminishes. Thus a document with full colour and voice annotation could decay with time through to a monochrome document with low-quality audio. Finally, it is compressed with only contextual and retrieval information easily accessible. Regularly used or vitally important documents would remain uncompressed and complete.

## Final Remarks

All of the technology described is either available or currently under development. However, very little has yet been integrated into a complete system that in any way reflects the potential gains possible. Creating an environment in which people are able to work intuitively, organise information and interact on a human scale should be a prime objective. The proposals and initial investigations presented here are a first step towards that intuitive 'office I wish I had'. Our aim is to break each of the interface barriers by a human orientation of technology to release the joint intellect of man and machine. The continued exponential cost reduction in electronic data storage, processing power and communication bandwidth now make this a real possibility. A decade from now could see it generally available in the work place.

## *Bibliography*


KRUGER, M. W. Artificial Reality II, Addison Wesley, 1991.

COCHRANE, P. et al. CAMNET. Interlink 2000, Aug. 1992.

ISHII, H., and KOBAYASHI, M. ClearBoard. CHI-92 Conference, May 1992.

COCHRANE, P., and HEATLEY, D. J. Optical Fibre Systems and Networks. Interlink 2000, Feb. 1992.


## *Biographies*


**Peter Cochrane**
BT Development and Procurement


Peter Cochrane holds a B.Sc. honours degree in Electrical Engineering and an M.Sc., Ph.D. and D.Sc. in Telecommunications Systems. He is a Fellow of both the IEEE and IEE and is currently a visiting professor to Essex, Kent and Southampton Universities, and a visiting Fellow to University College, North Wales at Bangor. He joined BT Laboratories in 1973. In 1987, he became manager of the Long Lines Division. He received the Queens Award for Technology in 1990 for his role as project manager in the production of optical receivers at BTL. In 1991, he was appointed to head the Systems Research Division which is concerned with advanced computing and communications.


**Kim Fisher**
BT Development and Procurement


Kim Fisher qualified as a product designer in 1975, with a B.A. honours degree in Industrial Design Engineering. He then worked for Russell Hobbs moving to Gillette UK Research Laboratories in 1978 and then Pye Telecom in 1979 (later Philips Radio Communications Systems). In 1985, he joined BT Laboratories to set up the Industrial Design Unit, becoming Industrial Design Manager for the BT products division in 1989. In April 1990, he joined the new Advanced Concepts Unit in the Systems Research Division.


**Rob Taylor-Hendry**
BT Development and Procurement


Rob Taylor-Hendry graduated as a product designer in 1989 with a B.A. honours degree. After further studies, he graduated in 1991 from Central St. Martins School of Art and Design. He subsequently joined the Advanced Concepts Unit in BT Laboratories' Systems Research Division where he has been working on aspects of the CAMNET and FutureDesk projects.

*Graham Mills and Ken Bayley*

# Corporate Visual Services—An Overview

*A phenomenal rate of growth is predicted for video communications. This article—the first of a series in the Journal exploring the provision of visual and broadcast services—sets the scene and shows how advanced terminal technology allows video communications to add value to network revenue.*

## Corporate Visual Services Market

Between April 1992 and March 1993, BT customers spent the equivalent of 12 years making calls on the international integrated services digital network (ISDN). To be precise, international basic-rate ISDN connections occupied a grand total of 6 271 006 B-channel minutes. Significantly, 52% of those minutes were used for videoconferencing traffic.

Perhaps the most significant statistic is that those figures represent a five-fold increase on the previous year. Allowing for a general recession in world trade during that period, a growth rate of such magnitude bodes well for the future. There is little reason to believe that it will not be sustained. These figures are based on actual BT experience. As such they make a starting point against which the predictions of market researchers can be measured.

One such forecast by an independent group projects the data traffic generated by just one 'typical' multinational corporation on a typical day in 1998. The figures were derived from a series of interviews with a wide range of large companies. They conclude that an average multinational corporation will generate enough traffic to occupy some 5% of the capacity of the TAT-8 transatlantic cable. A total of almost 3000 Gbits of traffic.

A very large proportion of those billions of bits will be derived from the transport of video information of one sort or another. Including both traffic to the USA and within Europe, they arrive at an aggregate of 29 000 video telephone calls and 23 videoconference sessions and 43 transmissions of broadcast-quality business video each day. To generate this much tele-video traffic, the multinational corporation will use 3800 videophones—or roughly one per desk.

While these predictions may seem high, in practice they are certainly achievable. The research questionnaire revealed that some companies are currently generating extremely high volumes of facsimile and electronic mail traffic. The rate of growth indicated for these two areas alone allowed the market researchers to deduce that by 1998 the multinational corporation could be originating over 200 000 electronic and voice mail messages each day, and some 211 000 pages of facsimile.

That level of usage computes to a telecommunications bill of around £1 million a day at current tariff levels. Even this is not so excessive as it may sound. At least one multinational complains that it spent over £200 million on telecommunications charges in 1992. It is calculated that 45% of the 1998 usage minutes will be accounted for by video traffic.

It is calculated (see Table 1) that revenues from daily video traffic demand for a multinational corporation in 1998 will total some £420 000 per day. That £420 000 per day per multinational corporation spent on video communications represents new business for the telecommunications carriers. It also presents an opportunity for significant sales of new terminal and other customer premises equipment (CPE) over the next five years.

In total, a worldwide market for equipment and traffic worth an estimated £390 million in 1992, will have grown to £19 billion by the end of the decade.

*advances in the network are bringing video communications within affordable reach of more people not only in large corporations but also among the very smallest*

**Table 1 Rough Approximation of Revenues from Daily Traffic Demand for a Multinational Corporation, 1998**

| | US – Europe | Europe – Europe |
|---|---|---|
| Bits per day | 1 970 000 000 000 | 975 000 000 000 |
| Seconds at 64 kbit/s | 30 781 250 | 15 234 375 |
| Minutes | 513 021 | 253 906 |
| Rates per Minute* | £1·40 | £0·85 |
| Revenue | £718 229 | £215 820 |
| Total | £934 049 | |
| of which 45% = video | £420 322 | |

* 1993 BT rates for international data calls

Among the factors identified as underlying this phenomenal rate of growth for video is a burgeoning requirement for interpersonal communications and in particular the communication of images. This points to the enormous potential demand for terminal equipment designed to support video communications such as videophones and videoconference systems. Taking into account the predicted growth rates for conventional methods of person-to-person data communication such as facsimile and electronic mail, coupled with the market forecasts for continued strong growth of sales of personal computers, then merging the functions of PC and video telephone into one desk top—or possibly portable—unit will be a winning combination.

## BT in the Visual Services Market-Place

But international and national telecommunications carrier markets of the 1990s are characterised above all by a relatively new word in the business—competition. While there are undoubtedly vast amounts of money to be made providing both the networks to carry all this new traffic and selling the customer premises equipment to allow it to be generated, gaining a fair share will require careful and strategic planning. And the lion's share will go to the company that plans the best and develops and deploys the best technology.

In this respect, BT is well on target. In the October 1992 issue of the *Journal*, a vision of the network of the future was described in detail. The implementation of such systems is an essential prerequisite for success in winning a significant share of future business. At the same time, the availability of video communications terminals will generate the need for the new networks for both inland and international use.

Tradition has it that, as technology advances, it also becomes less expensive. In video communications this tenet holds firm. Apart from reductions in absolute cost, advances in the network are bringing video communications within affordable reach of more people not only in large corporations but also among the very smallest.

The introduction of the ISDN in particular means that video links are no longer dependent on the use of relatively expensive leased MegaStream lines. With ISDN, video is not constrained to fixed point-to-point links—that is one factor in reducing ownership costs. At the same time, the cost of acquiring, maintaining and using terminal equipment is rapidly reducing, while also becoming available in a wider variety of formats.

Cost and circuit switching alone however are not the only important factors. Perhaps the most significant event of 1992 was the final ratification of the H.320 series of international standards that define parameters for interworking between video equipment manufactured by different vendors. Standardisation has also opened up the potential for

*Figure 1—BT's VC5000 videoconferencing unit*

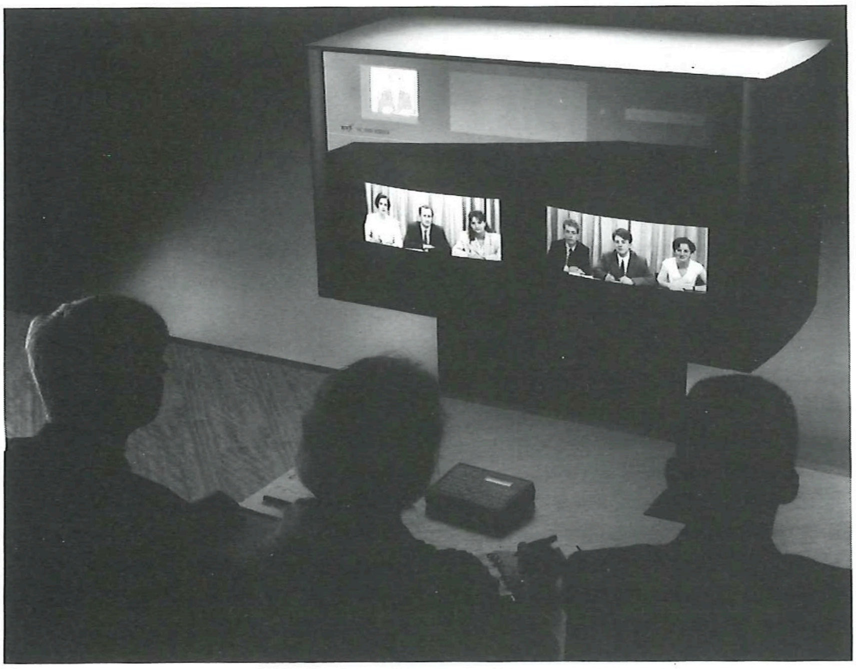


*Figure 2—BT's VC7000 videoconferencing unit*

private switched networking over PABXs, and for the future raises the prospect of video over local area networks. Simultaneously, the nature of video terminal equipment has also changed, no longer requiring expensively equipped soundproofed and specially lit studios but usable in normal office conditions.

So far as ISDN and video communications equipment sales are concerned it is very hard to say which is the 'chicken' and which is the 'egg'.

Currently, the only telecommunications company in the UK able to supply basic-rate ISDN service, BT has a significant leadership position in both inland and international markets. In order to ensure that position is not undermined, the company has assembled a comprehensive and still growing portfolio of video-communications products. Its development has been closely matched to the requirements of the market as they in turn have evolved. Future plans for new products will be closely geared to the evolution of broadband systems as they are deployed both in the trunk network and the local loop.

## BT Visual Services Products

The current BT Visual Services portfolio has grown from the top down, ranging from the VC5000 videoconferencing unit (Figure 1) able to handle data rates up to 2 Mbit/s, incorporating the VC2300 codec, down to the VC7000 desktop terminal (Figure 2). Later this year, the CoCo development will allow a desk top personal computer to become a combined ISDN and videophone terminal (Figure 3), and a digital videophone will follow soon after. All are compliant with the H.320 series of international standards.

## Technical Overview

A number of internationally agreed standards cover all of the technical processes involved in encoding video signals, compressing them ready for transmission, interleaving the encoded video with encoded audio, multiplexing the combined audio and video with other types of data and transporting the combined signal through a communications network and then reversing the processes. They were defined by working parties of the International Consultative Committee for Telegraphs and Telecommunications (CCITT).

Their main thrust is to ensure compatibility and reliable interworking between terminals from different manufacturers. In the case of the video and audio standards which apply to multimedia terminals such as the Video PC card, they do not seek to define, nor impose limits on, the quality of the pictures or sound generated. While they ensure connectivity, they do not give a guarantee of quality. That ultimately depends on the skill of the designer.

Video processing and transmission are governed by a group of three main standards which are grouped together under an umbrella standard H.320. This 'calls' all other relevant standards required to cover the technical requirements for combined audio and video conversations. It sets out the types of terminal and the transmission modes that they can use.

H.261 defines video encoding and decoding of digital video signals at data rates of between 64 kbit/s and 2 Mbit/s for live two-way transmissions such as videoconferences and videotelephony. The typical maximum bit rate for videoconferencing is 384 kbit/s. Terminals such as the VC7000 and Video PC cards, which are designed to work with basic-rate access ISDN, are expected to operate at rates which vary between the lowest set in H.261 and the maximum allowed by using two ISDN 64 kbit/s B-channels in parallel. In practice, the implied bandwidth of 128 kbit/s is seldom likely to be taken up entirely with video, since some will be required for audio and other data transmissions.

The picture input format required by H.261 is known as the *common intermediate format* (CIF). This specifies how the results of digitising video signals which have been generated using either of the two world analogue TV systems—PAL in Europe and NTSC in North America and Japan—should be presented to the encoder. It is needed because of the differing scanning frequencies and framing rates used by the TV standards—525 lines at 60 frames per second for NTSC and 625 lines at 50 frames per second for PAL.

Pictures are coded as luminance (brightness) and two-colour difference components, using codes and sampled values as defined in its CCIR Recommendation 601 as a standard for digital broadcast TV. This results in each TV frame being converted from the linear raster scan of the input TV signal to a two-dimensional array of picture elements (PELs). The result is an

*Figure 3—CoCo combined videophone and personal computer application*

effective compromise between NTSC and PAL standards.

The format specified for the array is 352 PELs wide by 288 deep for luminance information. Because the human eye is less sensitive to changes in colour than in brightness, sampling of the two-colour difference components is set at half the luminance rate, 176 elements per line, with 144 lines per frame.

The standard also specifies a lower resolution format, quarter CIF, which has half the number of PELs per line and lines per frame. The use of Q-CIF in a video encoder is mandatory according to H.261, while full CIF is optional. In both cases, each frame or quarter frame is divided into a coarser array of blocks, where each block contains two sets of 8 × 8 colour difference elements and four 8 × 8 arrays of luminance elements. Each block defines the detail of an area within its frame. The standard also specifies that there should be some method altering the rate at which frames are delivered from the CIF formatter to the input of the encoder by dropping up to three frames at a time dependent on the instantaneous bandwidth available on the communications channel.

H.261 specifies the use of a discrete cosine transformation (DCT) technique applied to each of the 64 elements within each block to arrive at an encoded numerical sequence which uniquely defines the amount of luminance and colour detail within that block.

It also calls for motion compensation and prediction by examining blocks in each frame with reference to the equivalent blocks in adjacent frames to determine whether their encoded values differ. Such differences represent motion in the picture. It then is only necessary to pass on data from the blocks where motion is occurring. This results in considerable savings in data throughput. However, the penalties incurred are an increase in processing power. It is estimated that to take full advantage of the techniques described in H.261 requires a processor to perform up to 6 billion instructions a second. It also requires each frame of data that describes a block to contain information that defines its position in the two-dimensional array.

Motion compensation and prediction are optional in the encoder, but decoders must have at least a limited ability to cope with such information. In general, specifications are more rigidly defined for decoding than for encoding.

The methods by which synchronisation of audio and video are achieved are specified in CCITT H.221. The standard defines how a transmission should be subdivided into subchannels so defines the order in which packets of encoded H.261 video are interleaved or multiplexed with the appropriate audio. It also specifies how other types of data which are not so time critical can be incorporated into the data stream, and how much bandwidth each should be allocated at any instant.

Recommendation H.242 specifies the protocols that are to be used to establish communications between two terminals. It defines how terminals with differing capabilities should signal the facts to each other in an unambiguous way so that they can negotiate the highest common level of performance.

For applications where time or bandwidth are not so critical as in live videotelephony, two more standards have been evolved for the processing of video information. Work on these has been carried out under the auspices of the International Standards Organisation (ISO).

The first is known as JPEG, after the Joint Photographic Experts Group, established in 1982 to develop picture coding and identification methods. As its title suggests, this standard is more concerned with reducing the size of high-quality still images for purposes of efficient storage and retrieval rather than rapid processing. It defines two algorithms for compression, one providing very high quality but at the cost of lower compression ratios. The second has proven more popular and uses a discrete cosine transform compression algorithm similar to H.261. However, there are significant differences in subsequent processing. In particular, the decoding process may be accomplished in such a way that the resolution of a picture is progressively improved as the decoding time increases.

Compared with H.261, all the information content of a picture is retained in a JPEG-compressed image. Although intended for still picture storage, it has been applied to the compression of motion picture sequences since the retention of total detail in each frame eases editing.

Complementing JPEG, the Moving Picture Experts Group (MPEG), initiated by the ISO in 1988, set out to define a method of storing motion pictures on media such as optical and magnetic disks and tape. The DCT

algorithm was chosen for MPEG's standard after a competition and ballot in 1989-90. It is similar to that specified in H.261, but the standard does not define intermediate formats equivalent to H.261's CIF and Q-CIF. It also uses a different technique for motion prediction since it is intended for use with video sequences containing more motion than usually occurs during a video conference or video telephone call.

In 1990, the ISO defined a need for a video-compression technique that could be used to code high-definition television broadcasts. Technical proposals for MPEG-2 were assessed at the end of 1991. Of the 30 submitted, most were based on DCT algorithms. The CCITT is actively collaborating in MPEG-2 development with a view to its becoming the basis for a video standard for broadband ISDN.

## Benefits of Video Communications

Although BT's main rivals are seen as other telecommunications service and system suppliers, video communications has also to compete with other types of carrier—airlines, railways and automobiles. Most potential users perceive the main advantage of videoconferencing as reducing the need to travel. While this is undoubtedly true, see Table 2, in fact there are many users who have found that there are many benefits to be derived from the use of videoconference equipment other than saving travel costs. For most, time is the most critical factor.

For example, the Ministry of Agriculture has found that a videoconference link that connects offices no more than 12 miles apart has resulted in more efficient use of executive time and faster decision making.

In 1990, the Ministry installed a videoconference link between its head office locations in Whitehall, and Tolworth in Surrey. At the time of the installation, one of the prime objectives was to determine whether the system would reduce travel costs. But cost, although important, has moved well down the list of priorities, and what was initially meant to be a limited-duration trial with equipment leased from BT has become an integral part of the Ministry's day-to-day running. A measure of its success is that the senior executives who use the video link four or five times week have put up severe resistance against any suggestions that it might be removed. As a result, the Ministry has now bought the equipment outright and fully intends to keep it in place, and is planning to extend the link to Brussels and possibly to regional offices within the UK. There are many other examples like this across BT's 1000-unit installed base in Europe.

**Table 2 Videoconferencing, London–New York**

| Conference Costs | Three Business-Class Air Tickets |
|---|---|
| 2 hours<br>(USA)<br>6 channels = £1008<br>2 channels = £336 | £2129 return × 3<br>(Virgin Atlantic)<br>= £6360<br>Plus subsistence, hotels = £??? |

Source: BT, 1993

## Conclusion

In conclusion, video communications are on the way to becoming almost as pervasive as the 'plain ordinary telephone'. That took almost a century. The arrival of the 'plain ordinary videophone service' will be just a few years in the making.

## *Biographies*

**Graham Mills**
**BT Visual and Broadcast Services**

Graham Mills is Manager, Portfolio and Business Development in BT Visual and Broadcast Services (VBS). He is responsible for major new product and service initiatives for VBS, for the international expansion of VBS business and for the overall direction of the VBS research and development budget. He has led the BT/IBM alliance to develop CoCo, the PC videophone service to be launched later this year, and the development of BT's entry into other European satellite services markets. He has previously managed BT's video-conferencing business and has experience in satellite, cable TV and computing operations within BT.

**Ken Bayley**
**BT Visual and Broadcast Services**

Ken Bayley is General Manager of BT Visual Services. His business unit, part of BT VBS, is responsible for managing BT's interests in teleconferencing and remote surveillance. He has been with the company for 29 years in a variety of sales, marketing and operational roles. In the early-1980s, he was instrumental in shaping BT's overall marketing direction and was involved in the original feasibility study on cable TV potential leading to BT's successful acquisition of the Coventry franchise in 1985. Ken took over BT Cable TV Services in 1988 when BT was the largest operator in the UK and formed his present unit in November 1990. He is a member of the Chartered Institute of Marketing.

*John Crackett*

# ISDN in the Dealing Room

*The ISDN seems ideally suited to the communication needs of the financial trading market, where speed of operation, flexibility, and functional richness are key. Until recently, however, customers in this market have shown understandable reluctance to risk the profitability of their business on an evolving technology. This article explores the needs of a trading communications system, suggests how ISDN lines may be integrated, and relates the progress of a team developing such equipment, both in the UK and abroad. Particular attention is paid to the applications that may be implemented for a dealing system, and how these may realise the potential for competitive advantage promised by ISDN.*

## Introduction

Recently, two grand events in the history of the integrated services digital network (ISDN) have taken place: The Transcontinental ISDN Project 1992 (TRIP '92) in the USA and The ISDN User Show in London. The end of this year will see the culmination of the Memorandum of Understanding (MoU)—an agreement among the 18 CEPT (European Conference of Postal and Telecommunications Administrations) countries to provide a common ISDN service by 1 January 1994. Recent figures show that 14 of the world's major telecommunications operators are cumulatively claiming almost one million basic-rate connections and over 35 000 primary-rate connections in service or on order. After many years of hype perhaps 1993 is the year when ISDN can finally be taken seriously.

In the wholesale finance market the signs are that this is the case. BT Customer Systems has been offering a Digital Access Signalling System No. 2 (DASS2) interface for its range of dealing room switches for a number of years with minimal take up. Only now are substantial orders being received. This is in contrast to the primitive, non-ISDN, T1 service offered in North America, where bulk orders were received immediately the product became available.

To understand why this may be the case, the requirements of the financial dealing environment must be considered.

## The Dealing Room

Most large banks operate wholesale businesses to meet the bulk money supply requirements of their retail outlets (that is, the high street clearing banks), corporate customers, and governments. Wholesale banking has other roles, and there are many other customers for dealing room equipment. For simplicity, however, money-trading by banks is considered here as an example.

Banks trade money for a variety of reasons. The primary reason is to make a profit. Like any business, the goal is to buy the goods as cheaply as possible and sell at the highest profit.

The forum for transacting this business is a *dealing room* (European) or *trading room* (American). This is an area in a bank where anything from one to 1200 individuals congregate to trade with other banks and institutions. In money transactions, banks deal principally with other banks.

A dealing room is segmented into three domains:

- The *front office*, where the dealers themselves are located. This is the biggest employer, often with 70% of the staff.
- The *middle office*, which contains researchers and strategists who advise the bank on its trading policy and support the ongoing strategy.
- The *back office*, where the transactions made in the front office are recorded, settlements are organised, and accounts are produced for analysis purposes. In many markets, it is a legal requirement for deals to be registered with a regulatory body. This is commonly the responsibility of the back office. For instance, The London Stock Exchange requires that equity deals in London be registered with them within 60 seconds.

The term *dealing system* here refers to the equipment satisfying the voice communications needs of front office staff. Such systems can connect any market participants in all the financial centres of the world.

*The performance of the dealing system plays a key role in the ability of a dealer to react fast enough to win a potentially profitable deal.*

## A typical dealer

A typical dealer requires access to a number of systems from his/her desk.

Access to the dealing system is through a dealer board or console. A dealer requires single-touch access to up to 100 lines. The status of all 100 lines should be visible at a glance as this is commonly used to gain an intuitive feel for the state of the market. Typically, dealers require several handsets. Potential clients are held on one handset while enquiries are made about the deal on another. Some dealers demand four handsets.

Many dealers require speaker systems. A user will call other traders and place the calls on speakers. The dealer monitors the changing prices spoken by the other traders throughout the day. If a price offers an attractive opportunity, the dealer will recognise the voice of the offering trader, connect a handset to the appropriate line, and complete the deal. Speaker systems are commonly part of the dealing system.

A dealer will also have access to a market data system. This is an information delivery system that presents financial data bought from specialist companies and other financial institutions. Information is delivered in two forms:

- *Video* The information is delivered as an RGB signal and displayed on monitor screens on the dealer's desk. Dealers normally share these services by using a keyboard to switch video services from screen to screen.

- *Data pages* The information arrives as a data feed. This data is formatted and presented in a readable form on a text-terminal, PC, or workstation. This form of information offers the advantage that specific values may be extracted ('shredded') from the data stream and used as an input to specialist financial dealing software.

## Needs of the dealing environment

When asked how they would like their trading system to be improved many dealers will be indifferent to extra bells and whistles and pragmatically reply 'faster telephones'. With the arrival of the ISDN, their wish may have come true. Speed of operation, however, is only one consideration when choosing a dealing system.

The general requirements for a dealing system can be summarised as follows:

- *Fast* The financial market reacts quickly to changes in the economic climate. During these periods of high activity (referred to as 'busy minutes') deals are initiated and concluded in seconds. The performance of the dealing system plays a key role in the ability of a dealer to react fast enough to win a potentially profitable deal. The dealing system must have enough throughput to process the extreme call rate experienced in these periods with no loss of performance. This is often cited as a failing of PBX systems when used in this application.

- *Functionally rich* Automation of common tasks combined with intuitive control interfaces throughout is crucial to fast and accurate operation. The functionality of the system must be well matched to the preferred working practices of the dealer involved; the closer the match, the more instinctively the dealer can operate in times of opportunity.

- *Flexible* There are at least as many working practices as there are instruments traded (such as currency or shares). As we have seen above, the match of working practice and console functionality is crucial to the effective operation of a dealer. Combined with this, the system must allow rapid and cheap rearrangements so that a business can evolve with the swiftly changing needs of its markets.

- *Small* The world's financial centres occupy some of the most expensive real estate in the world. Equipment-room floor space is therefore at a premium. The large array of information screens, speaker systems, personal computers, and workstations that modern dealers require leaves a very small desk footprint for the console to occupy.

- *Reliable* The loss of full or partial service for minutes or even seconds can cost a financial institution millions of pounds in lost revenue. A dealing system must be demonstrably reliable and fault tolerant.

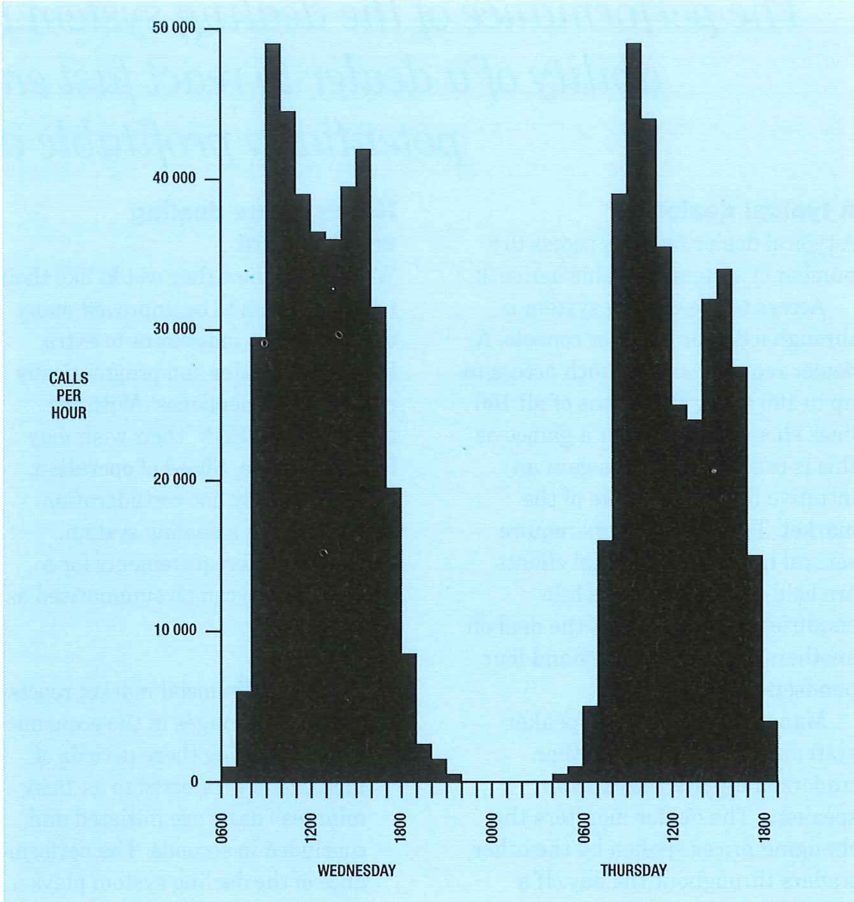
- *Quality of transmission* It is important that the parties involved in a transaction can clearly understand each other, even above the clamour of a dealing room. This is exacerbated by the large number of speakers and handsets that are routinely conferenced onto lines. These two factors mean that digital switching is a necessity.

During the fall of sterling from the exchange rate mechanism (ERM) a BT dealing system in the City of London serving 350 dealers with 3000 lines twice logged a traffic rate of 49 000 calls in one hour. The momentary peaks during this period are likely to have been much higher. Figure 1 shows a graph of the traffic rate over this period (Wednesday 16 and Thursday 17 September 1992).

## ISDN

The ability of ISDN equipment to fulfil or influence positively the factors described above is key to its ready acceptance in the financial community. The benefits of ISDN may be assessed as follows:

*Figure 1—Traffic from a particular BT dealing system (Wednesday 16 and Thursday 17 September 1992)*




- *Size* The use of common-channel signalling allows a primary-rate ISDN line containing 30 digitally-presented channels to be managed from one printed wiring board. A similar number of analogue lines requires an array of signalling and analogue-to-digital conversion cards. ISDN can therefore offer a considerable space saving.

- *Speed* When combined with appropriate terminal equipment (TE), the ISDN can offer sub-second, one-touch connection. When compared with an analogue DTMF PSTN line this is a significant improvement.

- *Reliability* . As an evolving technology, the ISDN must stand the test of time to allow customer confidence to build.

- *Transmission quality* Offering complete end-to-end digital connection, ISDN lines do not suffer from the deterioration experienced on analogue lines, regardless of the geographical separation of the parties involved in the call.

- *Functionality and flexibility* With its in-built support for many forms of transmission media (speech, video, fax, etc.) and sophisticated network services (number identification services, multiple subscriber number, closed user group, etc.), the ISDN is well placed to satisfy most users' functional requirements.

This demonstrates that ISDN can meet most of the trading system requirements admirably. Considering this, why has the uptake of ISDN lines on dealing systems been so slow? Confidence is certainly an issue. This will be addressed as ISDN is recognised as an established and reliable service. A more serious problem is the lack of quality TE that capitalises on the flexibility and functionality that ISDN has to offer. These factors give tremendous scope for automation, scope that is not being fully exploited.

## Integrated Trading System

To serve the financial community, BT Customer Systems has developed the Integrated Trading System (ITS) digital platform. Figure 2 shows a block diagram of an ITS digital platform. A fully equipped ITS digital platform can connect 6000 lines to 6000 handsets or speakers under the control of 2000 consoles.

*the ISDN can meet most of the trading system requirements admirably*

### ITS digital platform

Circuits are switched as 64 kbit/s, A-law or $\mu$-law B-channels. Switching is performed under the management of a hierarchical, microprocessor-based, distributed control architecture. The distributed nature of the architecture ensures a high maximum throughput. The control components communicate through Ethernet and high-speed high-level data link (HDLC) buses.

To meet the stringent dealing requirements, the following facilities are standard:

- *Full availability* Any handset may be connected to any line. Through the use of, for example, touch-sensitive displays, a console may display and control the state of up to 3000 lines.

- *Non-blocking* At the heart of the ITS digital platform is a one-stage square switch. A cross-point always exists to connect any handset to any line, regardless of traffic rate or the number of simultaneous calls.

- *Fully redundant* The switch block, clocks, power-supply, control system, and control buses are duplicated. All have automatic failure detection and change-over.

- *Sub 100 ms connect time* The typical time for an audio path to be routed across the ITS digital platform is 70 ms. Under laboratory-generated heavy traffic conditions, the slowest time observed is 160 ms.

## ISDN interface for the ITS digital platform

The ITS digital platform may connect to an ISDN at the primary rates of 2·048 Mbit/s (CEPT rate) or 1·544 Mbit/s (T1 rate). The quantity of lines that dealing systems require makes the use of basic-rate services uneconomical. A basic-rate interface is a possibility for the dealing-system-to-desk interface as most dealers require only two handsets (effectively making the console an ISDN terminal). This does not address the need for speakers and it is unlikely that the 16 kbit/s signalling channel can accommodate the high rate of information transfer necessary.

Figure 3 shows a schematic of the ISDN interface for the ITS digital platform.

The interface is implemented using the digital line interface card (DLIC). The DLIC terminates one T1- or CEPT-rate trunk, with either µ- or A-law encoding. The DLIC is the base for distributed ISDN applications on the ITS digital platform. To guarantee high performance, even under heavy traffic conditions, the DLIC contains a 32 MHz 68EC030 central processing unit (CPU), with capacity for 2 Mbyte ROM, 4 Mbyte RAM, and 512 kbyte non-volatile storage. The DLIC achieves a performance of one call per channel per second with considerable CPU bandwidth remaining for application processing. This is faster than any of the national networks met so far. The exact traffic rate and spare CPU throughput depends on the capabilities of individual national ISDNs. Should extra processing be required the DLIC includes a spare HDLC port for connection to an external processor.

## Applications

The sections above identify the requirement for quality TE that capitalises on the functionality, flexibility, and speed of ISDN services. Specifically, this TE must support specialist applications that serve the needs of the financial

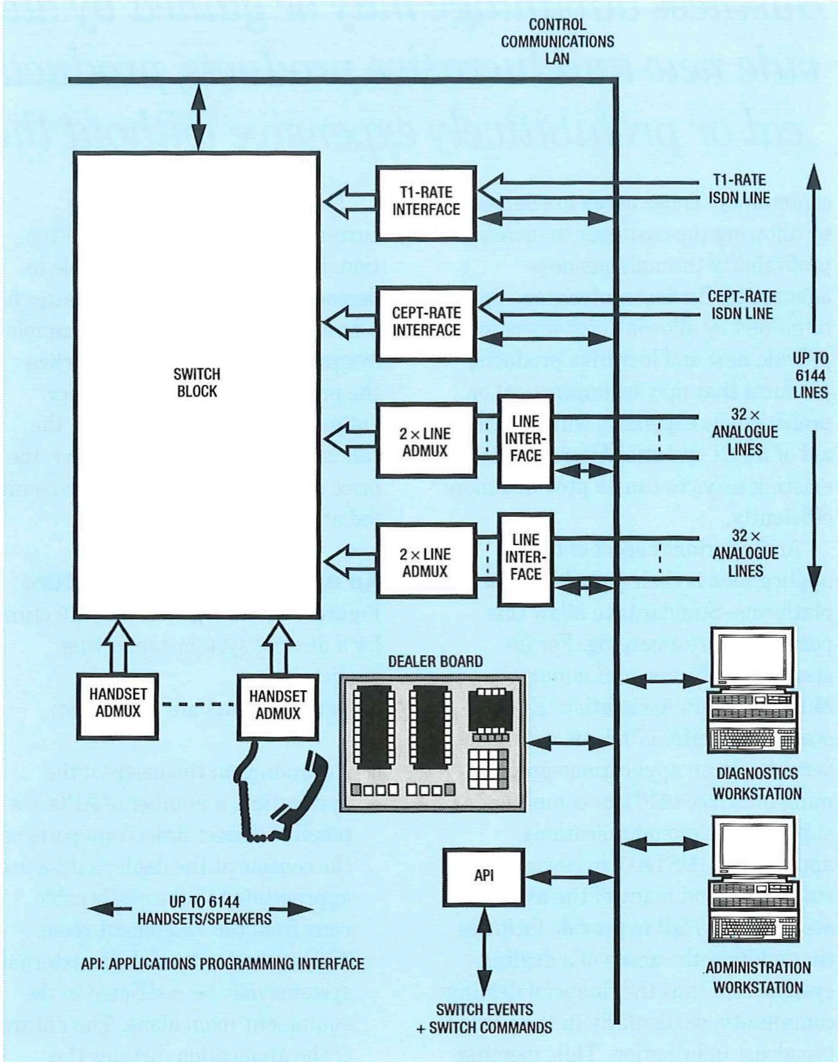
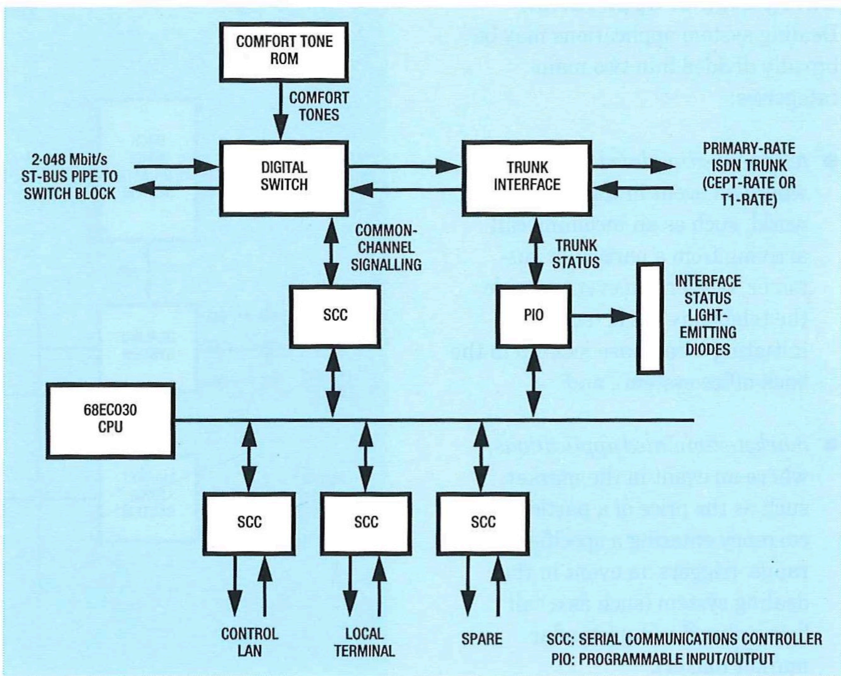



*Figure 2—ITS digital platform*

*Figure 3—ISDN interface for the ITS digital platform*



*Business advantage may be gained by allowing customers to provide new and lucrative products, products that may be impractical or prohibitively expensive without the aid of ISDN systems.*

community. These needs are served by allowing the customer to increase profitability through business advantage. Business advantage may be gained by allowing customers to provide new and lucrative products, products that may be impractical or prohibitively expensive without the aid of ISDN systems. Alternatively, existing services can be provided more efficiently.

An important aspect of these applications is their portability across platforms. Standards to allow this portability are emerging. For instance, the European Computer Manufacturers Association (ECMA) standard ECMA-179 deals with services for an applications programming interface (API) for computer-supported telecommunications applications (CSTA). However, these standards (and many of the associated services) fail to provide facilities that address the needs of a dealing system, and thus the financial dealing community, particularly in the area of broadcast information. This, together with the immaturity of these specifications, means that the applications developed within the short and medium terms are likely to be proprietary in nature.

## Categories of application

Dealing system applications may be broadly divided into two main categories:

- *telephony-stimulated applications*, where an event in the telephony world, such as an incoming call arriving from a particular customer, triggers an event outside the telephony world (such as initiating a database look-up in the back-office system); and
- *market-stimulated applications*, where an event in the market, such as the price of a particular currency entering a specified range, triggers an event in the dealing system (such as a call being placed to a particular market maker).

The former applications are currently attracting the most attention. However, BT has been able to demonstrate examples of the latter for a number of years. A simple example is a pager call being initiated when the price of a particular currency enters a specified range. When the call is placed to a message pager, the price of the currency may be transmitted and displayed.

## An applications architecture

Figure 4 shows a general architecture for a dealing system supporting applications.

Several points are of interest:

- Depending on the needs of the application, a number of APIs are possible. Direct links from ports on the console at the dealer's desk are appropriate to save costly cable runs from the equipment room. Alternatively, the links to external systems may be restricted to the equipment room alone. The nature of the application dictates the appropriate choice.
- It may be necessary to interface with several external systems. This could be used to justify a bus-based API, rather than point-to-point.

## Examples of applications

The following are examples of the types of application that can be used to exploit the benefits of ISDN. It is interesting that some of these applications could be implemented in a limited way on some dealing systems without the use of ISDN at all. ISDN is proving to be the catalyst that stimulates interest in this area.

All the following examples fall into the telephony-stimulated category of application.

### *Caller identity display*

The simplest application is to present the identity of a caller or callers to a dealer before he/she answers the call. Most ISDN implementations provide the identity of the caller in the form of a network address. This is referred to as the *calling line identity* (CLI). It is unreasonable to expect a dealer to

*Figure 4—Architecture for dealing system supporting applications*

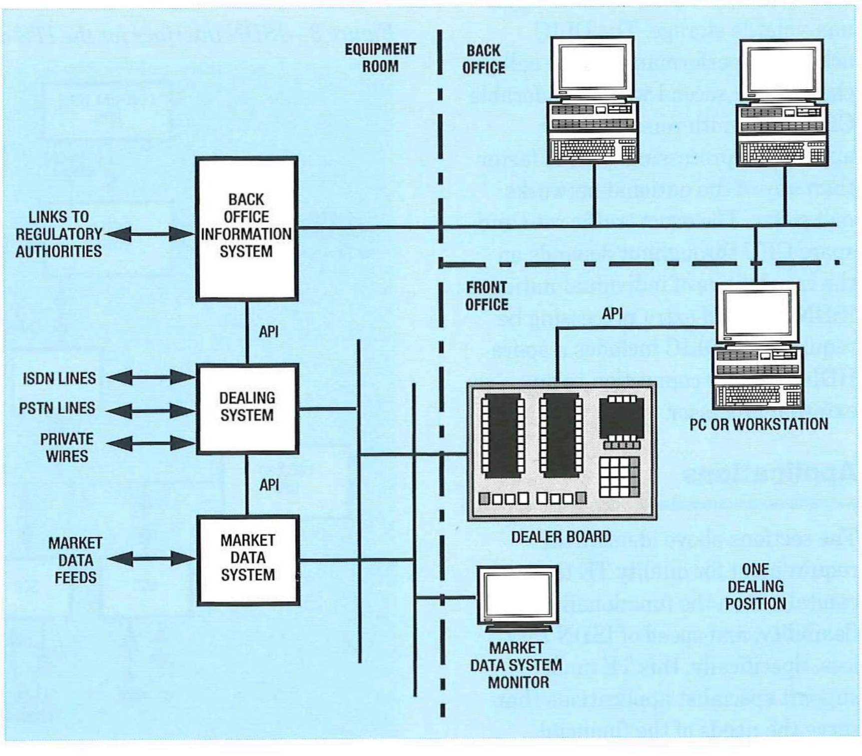
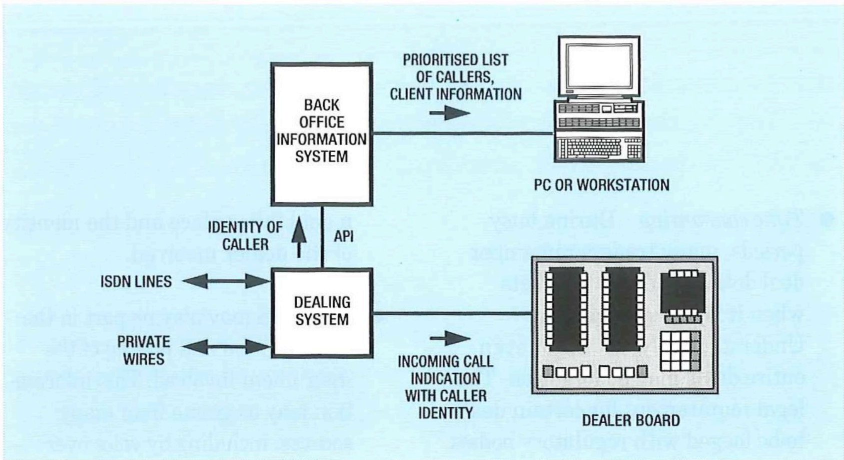


Figure 5—System providing client information




remember the telephone number of every customer who may call. Instead it is necessary for the system to translate this number into a mnemonic label that is displayed as part of the incoming call indication. This allows the dealer to identify a caller before a call is answered and prioritise simultaneous calls.

***Virtual private wire***

The concept of caller identification can be taken one stage further to provide private-wire functionality from ISDN services. Private wires are normally justified on the following basis:

- *Cost* The volume of traffic between the two parties is such that the per-use cost of a dialled connection would be greater than the fixed cost of a private wire.

- *Performance* The counter party is a valued customer. It is in the interest of the business that calls to and from the counter party are connected and answered swiftly. In these cases the delay incurred by a dialled connection may not be acceptable.

Normally, private wires are controlled by a dedicated key. Depressing the key signals or answers the distant end. By using the number identification services of the ISDN, calls from a specific counter party can be routed to the relevant dedicated key. Calls to the counter party are automatically dialled over the ISDN when the relevant key is pressed. The high-speed connection of ISDN allows the performance on most national networks to be acceptably close to private wire performance. The choice between dialled or private connection can then be made solely on a cost basis.

***Risk management***

It is obviously important for a dealer to understand the risk associated with any particular deal. If aspects of this risk are understood before a call is answered the dealer may prioritise and answer the most favourable first.

There are many factors associated with risk. A simple example is the use of the credit limit. If a dealer is aware that an incoming call is from a client who has no remaining credit, and he believes the client wishes to buy, it would not be prudent to give the call a high priority.

Client information is commonly held on a back-office database. Once a call has been answered and the client recognised, the dealer should check the relevant information from this database. Database look-up can be a time-consuming activity, and during busy periods this may not be rigorously performed.

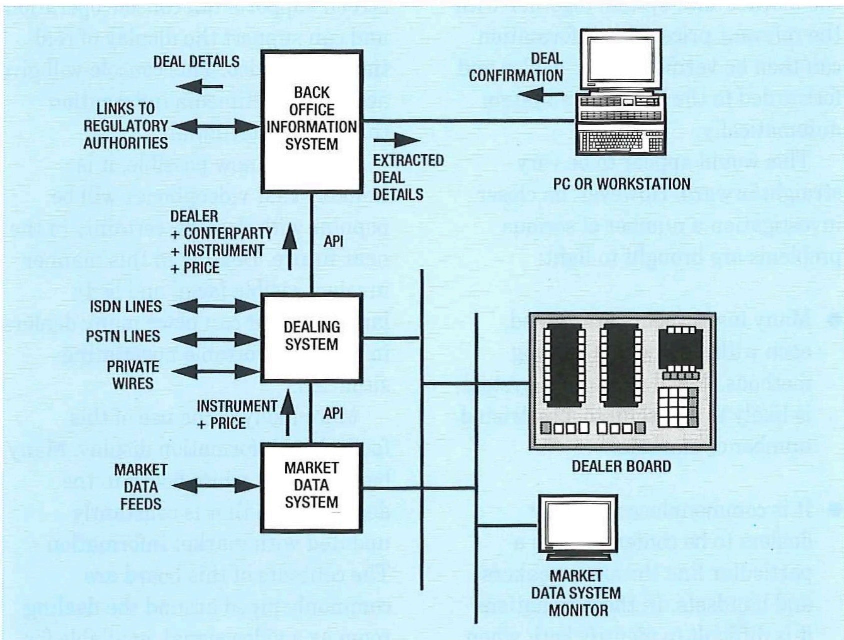
Figure 5 shows a system that can provide solutions to these problems.

When an incoming call arrives, the caller is identified by the associated CLI. This information is passed over the API to the back-office database system which begins the database look-up before the call is answered. Once the information has been found the call can be prioritised by a display on either the dealer's console or workstation. When the call is answered, the dealing system and database application can conspire to ensure that the necessary information is displayed automatically on the relevant dealer's workstation, either instantaneously or when it is available.

***Deal capture***

Traditionally, the conclusion of a deal involves each trader writing the details onto a deal ticket. These are collected at frequent intervals and passed to the back office for entry into the clearing system. As with many manual processes, there are a number of problems associated with this:

Figure 6—Automated deal capture system



- *Time consuming* During busy periods, many traders remember deal details and create tickets when it is more convenient. Understandably, details or even entire deals may be forgotten. The legal requirement for certain deals to be logged with regulatory bodies within specified time frames may also be jeopardised.

- *Error prone* Tickets are hurriedly hand-written. Errors, such as the wrong counter-party or instrument, are frequently introduced into the system. Thankfully, most of these are resolved within the back office and are not propagated to the outside world.

- *Open to abuse* It is possible for deal tickets to be lost in drawers until market conditions become more favourable, or for dealers to agree the price some hours after they have agreed the deal.

Figure 6 shows a system to automate deal capture.

Details of the local and distant party are available from the dealing system (through the console reference and CLI). The instrument traded may be derived from knowledge of the local trader, or from the pages viewed on the market data system together with the relevant price. This information can then be verified by the dealer and forwarded to the back-office system automatically.

This would appear to be very straightforward. However, on closer investigation a number of serious problems are brought to light:

- Many instruments are traded, each with a variety of dealing methods. Any deal capture system is likely to be useful to a restricted number of markets.

- It is commonplace for many dealers to be conferenced to a particular line through speakers and handsets. In these situations it is difficult to identify both when a deal takes place and the identity of the dealer involved.

- The MDS may play no part in the identification and pricing of the instrument involved. This information may originate from many sources, including by voice over speakers or from a colleague nearby.

- Initial results of a recent investigation suggest that the deal ticket may be surrounded by deep set issues of culture and tradition, issues that are likely to cause the automation of deal capture to meet opposition from certain sectors of the finance market.

The possibilities for automating deal capture are tempting. Indeed, products are available for this task. It is the author's opinion, however, that any implementation can at best only partially fill a ticket, perhaps removing a valued aspect of the dealer's job in the process. Any system must be implemented with caution and is likely to be useful to a limited subset of the market.

***Multimedia information sale***

BT Customer Systems has recently developed a console based on colour LCD technology. The colour touch-screen supports full console operation and can support the display of real-time RGB video. This console will give access to multimedia information through one terminal.

Although now possible, it is unlikely that videophones will be popular with dealers, certainly in the near future. Dealing in this manner involves visible facial and body language that can place many dealers in an uncomfortable negotiating situation.

More likely is the use of this facility for information display. Many banks have a white board in the dealing room that is constantly updated with market information. The contents of this board are commonly piped around the dealing room as a video signal, available for display on monitors on dealers' desks. The use of a video window on a multimedia terminal for ad-hoc references to these boards frees other monitors or valuable desk space.

A bank may offer this and similar information for sale. ISDN provides the ideal transport mechanism offering the following benefits:

- *Functionality* The ISDN may manage the transport of information in a wide variety of ways (including video and raw data).

- *Security* Customers can be identified by their CLI before any information transfer takes place.

- *Flexibility* When a customer buys information it is likely that they will immediately follow its delivery with a purchase or sale. If this is the case, the call over which the data was delivered may be changed to a voice call and routed to the appropriate dealer. The identity of the customer and the nature of the purchased information can be used to identify which dealer is appropriate.

Information services of this type are already being developed. Information delivered in this way may be so volatile that the price charged is dependent on the age of the data; that is, the newer the information the higher the price charged for it.

## Progress

To date, BT Customer Systems has developed ISDN interfaces for the following countries:

- the UK (DASS2), and

- Japan (INS-Net 1500).

Trials are underway for the following countries:

- France (Numeris), and

- Germany (1TR6).

Development is underway for ETSI (European Telecommunications Standards Institute) ISDN.

All ISDN interfaces being developed support

- direct dialling in (DDI), and
- calling line identity (CLI).

Work is well underway on more sophisticated applications.

It is interesting to note the technical differences surrounding ISDN in its various incarnations across the globe. Arguably the Japanese have the most advanced service. The INS-Net implementation is virtually identical to the CCITT specification, differing only in the mandatory support of advice of call charge and the lack of support for overlap dialling. This is in contrast to France and Germany where considerable differences exist in the Numeris and 1TR6 implementations, notably the lack of a standard bearer capability information element in 1TR6.

## Conclusion

Arguably, ISDN has reached critical mass and is here to stay, whether particular markets want it or not. Indeed, reports are that customers in France are being offered primary-rate ISDN as the only form of delivery for PBX exchange lines.

As a telecommunications service, ISDN is without doubt a huge technological advance. It is now the responsibility of TE manufacturers to produce equipment compliant with international standards that capitalises on these advances in a way that is financially and culturally attractive to prospective customers. As a uniquely demanding market, this is particularly true for financial dealing systems.

## *Acknowledgements*

The author would like to thank the following colleagues for the their assistance in the preparation of this article: Marianne Holmes, Ian Salter, Marc Steatham, Steve Rooney, Dr. George Wloch, and Roger Corry.

## *Biography*

**John Crackett**
**BT (CBP) Ltd.**

John Crackett joined BT in the Newcastle District as an apprentice in 1981. After his apprenticeship he was involved in transmission construction. In 1986, he began a Minor Award at the University of Manchester Institute of Science and Technology (UMIST), graduating with a first class honours degree in Computation in 1989. In August 1989, he joined BT (CBP) Ltd, where he has been project leader for digital line interfaces for the last three years.

*Michael Parkin*

# Assessment of Network Performance: The ISDN2 Performance Analyser

*This article introduces a system that has been developed to provide a national indication of the performance of data calls carried within BT's basic-rate integrated services digital network (ISDN). The system described has been termed the ISDN2 performance analyser.*

## Introduction

BT launched its integrated services digital network (ISDN) basic-rate service, known within BT as *ISDN2*, in January 1991 and has rapidly rolled-out this service across its network.

A part of the ISDN launch process has involved the development, and deployment, of a system that provides an indication of the performance of data calls in terms of what ISDN customers would tend to experience when using the service. The system, which has been developed at BT Laboratories under BT Worldwide Networks' sponsorship, has become known as the *ISDN2 performance analyser* (IPA). This article outlines the development of the IPA and describes its proposed use.

The ISDN has been described in detail in a previous edition of the *Journal*[1] and it is not intended within this article to describe the ISDN in detail except when it is necessary to explain a particular aspect of the IPA.

## Call Performance Parameters for the ISDN

Before describing the IPA in detail, it is useful to describe a number of data call performance parameters that may be assessed using the IPA.

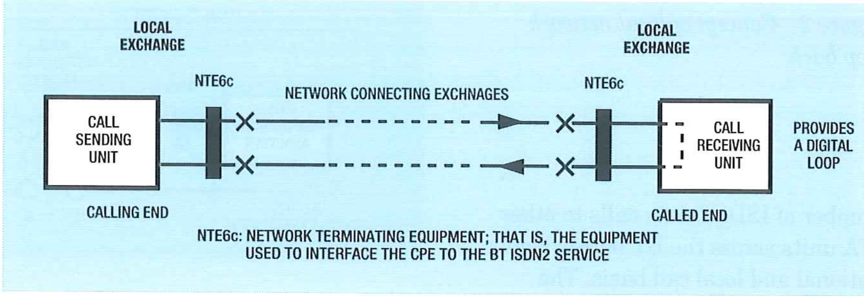
The performance of digital networks has tended to be assessed in terms of the parameters recommended by the International Telegraph and Telephone Consultative Committee (CCITT) within Recommendation G.821. However, G.821 performance parameters tend to be referred to fixed-link digital networks and can not be easily applied to switched networks that include ISDN data calls for example. To assess the performance of a digital system in terms of G.821 parameters requires the collection of a large statistical sample requiring a period approaching 30 days. It is feasible to collect a suitable sample for a fixed-link connection, but to collect a sufficiently large sample for a switched data call would require that call to be held for 30 days and would not be representative of ISDN2 calls that tend to be of short durations.

The parameter set described within this article has been drawn from the findings of a BT committee which recommended a number of call performance parameters that may be used to assess switched system performance and can be applied to ISDN2 data calls. The committee, entitled the *Performance And Quality Experts Team* (PAQET), based its parameters on a number of factors including customer expectation and internationally based recommendations.

These data call performance parameters may be grouped into three categories related to the progress of a switched data call:

- call establishment phase,
- data transfer phase, and
- call release phase.

Figure 1—Concept of the IPA




These categories are outlined as follows:

### Call establishment phase

This includes:

***National call establishment***
For the purposes of the IPA, this time delay refers to the delay for the network to establish an ISDN2 connection between the calling and called ends once the called end's ISDN2 number has been completely dialled. It applies to both nationally and locally established ISDN2 calls.

### Data transfer phase

This includes:

***Call early release***
For the purposes of IPA, for the set call holding time, if the call releases before the calling end issues a call release request to the network, then this is recorded as a call early release (call drop-out).

***The signal propagation of the connection***
Once IPA establishes a call, information to be conveyed from one end of the connection to the other end experiences a finite time delay as it travels through the circuits forming the connection. This signal propagation time delay is assessed by the IPA in terms of the delay for a specific digital sequence to be returned to the calling unit from the called unit when the connection has been 'looped' at the called end. This measurement provides an indication of the network's round trip delay. Halving this figure provides an indication of the connection's signal-propagation delay between the calling and called ends of the connection.

The following parameters within the data transfer phase are referred to the 64 kbit/s level:

***60 second periods error free***
For each data call made, a record is kept of minutes where no errors occurred.

***60 second periods containing errored seconds***
For each data call made, a record is kept of minutes where errored seconds occurred.

***60 second periods containing 10 contiguous severely errored seconds***
For each data call made, a count is made of when 10 contiguous severely errored seconds occurred within each minute.

### Call release phase

***Time delay for the network to release a call***
For the purposes of the IPA, this has been taken as the time delay for the network to release an established data call on submission of a call release request from the calling end to the point when the network is at its IDLE state able to accept a subsequent call establishment request.

## Outline of the ISDN2 Performance Analyser (IPA)

The ISDN2 performance analyser (IPA) comprises three sub-units that form the system:

- call sending unit (CSU),
- call reception unit (CRU), and
- data control unit (DCU).

The CSU is able to dial up automatically a CRU and establish an ISDN2 data call through the network. On the receipt of an incoming data call, the CRU digitally loops the send and receive directions of transmission to allow the CSU to perform tests based on it sending and then receiving a 64 kbit/s pseudo-random data pattern. The test call proceeds for three minutes when the CSU terminates the call. Approximately 30 seconds elapse before the CSU establishes another ISDN2 call to a different CRU. This elapsed time is used by the CSU to collate the performance data obtained from the ISDN2 data call made to the CRU.

Each CSU can be programmed to follow a call sequence that is repeated every 24 hours. The call sequence programmed will include:

- up to twenty CRU ISDN2 numbers, each number containing up to 20 individual digits (from 0 to 9), and
- three times within a 24 hours period when an IPA CSU becomes activated.

In addition to the call sequence, each IPA unit has an internal clock and calendar to record the date and time details for the data obtained from the ISDN2 data calls made.

At the end of its call sequence, the CSU establishes an ISDN2 data call to the data control unit (DCU) and down-loads the performance information that it has recorded for the data calls made to a number of CRU stations.

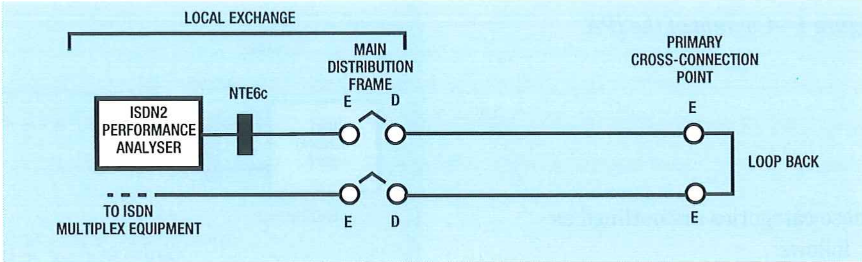
During the periods when a CSU is not activated, and not making calls, it acts as a CRU accepting calls from other IPA CSUs.

The concept of the CSU and CRU is illustrated in Figure 1 for further clarity.

## IPA Deployment

IPA units can be programmed to make a series of ISDN2 data calls to other IPA units commencing at three specific times during a 24 hour period. The deployment of several IPA units within the BT network at its extremities, and intermediate points, allows each IPA to make a

*Figure 2—Concept of local network loop back*




number of ISDN2 data calls to other IPA units across the BT network on a national and local call basis. The information collected from the ISDN2 data calls made across the BT network then allows an indication of the performance of the ISDN2 service to be made.

Current deployment of IPA units has been scheduled to include the siting of IPA units at the following locations:

| | | |
|---|---|---|
| Lerwick | Birmingham | Faversham |
| Inverness | Holyhead | Basingstoke |
| Fort William | Swansea | Bristol |
| Edinburgh | Cardiff | Penzance |
| Belfast | London | |
| Manchester | Dorchester | |

Three of the locations act as CSUs with the remaining locations acting as CRU within a 24 hour period. After a number of days, the CSU locations are changed and three other CRUs are programmed as CSUs. The management of the CSUs in this manner allows call generation on a sample basis across the UK and minimises the number of data calls made.

## Method of Connection to the BT Network

The location of IPA units tends to be at BT exchanges, and access to the BT network has been arranged to include an element of the local loop. This has been realised by using a looped-back connection from a primary cross-connection point (PCP) through the main distribution frame (MDF). This arrangement allows any digital corruptions introduced by the local access network to be taken into account within the results obtained through using the IPA.

The NTE6c, used to interface the IPA unit with the ISDN2 service, is situated with the IPA unit and the connection is made to the MDF where it is extended to a PCP. Here it is looped-back to the MDF and extended to the ISDN multiplex equipment (IMUX).

The provision of IPA access lines in this manner approximates to the connection arrangements that are used to provide ISDN2 customers with access to the BT network. IPA performance results gained in this manner are more representative of the performance that ISDN2 customers would tend to experience. Figure 2 illustrates this concept further concerning the connection arrangements used to interface IPA units with the BT network.

## IPA Phase 1 and Phase 2 Physical Arrangements

IPA has been developed in two phases. Phase 1 has been introduced at a limited number of sites within the BT network to gain experience of operating and managing the system. In turn, Phase 1 has allowed a limited assessment of the ISDN2 data call performance to be made. However, a limitation of this phase is that CSU call sequence programming has to be performed manually necessitating a site visit or the support from exchange staff.

Phase 2 is targeted to start from mid-1993 onwards and has the advantage of enabling CSU call sequence programming to be performed centrally from the DCU location. This is to be achieved by establishing ISDN2 calls from the DCU to a particular IPA unit and down-loading over the ISDN2 connection the CSU call sequence for that IPA unit. Central control of IPA units from the DCU offers flexibility not only in call sequence programming but also for the 'rebooting' of remote stations. The facility to manage which IPA stations are activated as a CSU or CRU becomes easier with the introduction of Phase 2.

## Assessment of Network Performance

The PAQET-recommended parameter set forms the basis for the measurements made using IPA for the ISDN2 service. The use of the PAQET parameters enables the assessment of the performance of data calls, carried within the switched network, to be undertaken. For the ISDN2 data calls made using IPA since February 1992, the performance recorded indicates a level that substantiates the targets that have been provisionally set using PAQET-based parameters.

The assessment of 'switched' data calls is difficult to undertake using the CCITT Recommendation G.821 parameters because these tend to be referred to continuously established data connections within a fixed-network (for example, KiloStream). However, the collection of PAQET-based parameters over a considerable time period allows an indication of the G.821 performance of a switched network to be assessed if all call durations are summated and measurement is made at the 64 kbit/s level. CCITT Recommendation G.821 suggests that a 30 days monitoring period is advisable. Applying this suggestion to IPA, a 30 days monitoring period indicates the collection of information from the establishment of 14 400 ISDN2 data calls.

## Conclusion

This article introduces a system that has been developed to allow an indication of the data call performance of BT's basic-rate integrated services digital network (ISDN2) to be assessed on a basis similar to that which may be experienced by ISDN2 customers. The system that has been developed to perform this purpose has been termed the *ISDN2 performance analyser* (IPA).

Since launching its ISDN2 service, in January 1991, BT has rapidly rolled-out this service across its network. A part of the ISDN post-launch process involved the necessity to develop a system that allows an

assessment of the call performance to be made in terms of what ISDN2 customers may actually experience.

The IPA system was initially deployed to allow a field evaluation of its functionality from February 1992 as IPA Phase 1. The results obtained from the field evaluation have been used in developing the second phase of IPA that is to be introduced from mid-1993 onwards. IPA Phase 1 will continue to be operated until IPA Phase 2 has been deployed to maintain an indication of the call performance for the ISDN2 service.

IPA Phase 1 has allowed an indication of a number of network parameters to be assessed that include:

- call establishment delay,
- call early release,
- digital performance quality, and
- call release times.

IPA Phase 2, in addition to the facilities provided by Phase 1, allows IPA out-stations to be remotely configured, provides the facility to monitor other performance parameters and includes a comprehensive post-processing package.

IPA units interface with the BT network in a similar manner to ISDN2 customer premises equipment (CPE) through the NTE6 line termination units. This allows the facility to deploy IPA unit at any exchange within the BT network that provides ISDN2 service.

IPA, once deployed, acts to provide an independent source of call performance assessment and has allowed BT to monitor the ISDN2 service on a post-launch basis.

## *References*


1 MARSHALL, J . F., and WELSBY, F. A Multiplex Solution for Initial ISDN Provision. *Br. Telecommun. Eng.* Jan. 1991, **9**, p. 253.

2 GRIFFITHS, J. M. ISDN Explained, Second Edition. John Wiley and Sons.


## *Acknowledgements*


The IPA has been developed under BT Worldwide Networks sponsorship at BT Laboratories' Network Interface and Protocol Evaluation Team lead by Mr. D. Nash to whom the author passes acknowledgements.

The author acknowledges the support provided by John Marshall and Fred Welsby in the preparation of this article.


## *Glossary*

**CCITT** International Telephone and Telegraph Committee.
**CPE** Customer premises equipment
**CSU** Call sending unit
**CRU** Call receiving unit
**DCU** Data collection unit
**IMUX** ISDN multiplex equipment
**IPA** ISDN2 performance analyser
**ISDN** Integrated services digital network
**ISDN2** BT term for its basic-rate ISDN service
**MDF** Main distribution frame
**NTE6c** Network Termination Equipment 6c
**NTP** Network termination point
**PAQET** Performance and Quality Experts Team
**PCP** Primary cross-connection point

## *Biography*


Mike Parkin joined Post Office Telecommunications in 1976 as an apprentice in the Guildford Telephone Area. After the completion of his apprenticeship in 1979, his duties included line transmission system and microwave radio maintenance. Having followed the City and Guilds of London Institute Telecommunications Course 271 in telephony and radio systems, he gained a place at the University of Manchester Institute of Science and Technology (UMIST) in 1981 to read electrical and electronic engineering, graduating in 1984 with a first class honours degree. He gained an Executive Engineer's posting in Thamesway District. He moved into BT headquarters in 1986 to work within the BTUK Network Standards Division. Currently, he works within the Worldwide Networks ISDN Programme Office and has responsibilities for the project management of items related to the quality of service of the ISDN service. He is a member of The Institution of Electrical Engineers and a Chartered Engineer.

*Trevor Kent*

# Standards for ISDN Architecture

*During the last two CCITT study periods there have been rapid developments in the technology related to telecommunications networks, both in transmission, with the potentially massive increase in bandwidth, and in the computers and software for the control of exchanges and management of networks. Architecture standards need to be in place in sufficient time for the development of the detailed standards needed for full exploitation of these improved technologies. This article reviews the development of those standards.*

## Introduction

In an earlier article[1], the CCITT recommendations for the integrated services digital network (ISDN) developed in the 1981–1984 study period of the CCITT were reviewed. Subsequently, there have been two further study periods, 1985–1988 and 1989–1992, during which existing recommendations have been enhanced and additional recommendations have been developed. For the purposes of this article, architecture is defined as *the classification and assignment of functions*. Recommendations on architecture define the structure of the ISDN so that recommendations dealing with the more detailed aspects of the network, such as services, signalling systems and information flows have a basis to build upon.

The three most important developments since the last article was published are the broadband ISDN (B-ISDN), the intelligent network (IN) and the telecommunications management network (TMN). The broadband ISDN is concerned with the delivery of high bandwidth services made possible by asynchronous transfer mode transmission and switching and optical-fibre cabling, but has not aligned well with the architectural concepts developed for the (narrowband/64 kbit/s-based) ISDN, requiring additional recommendations. The intelligent network is primarily concerned with a revised network architecture which enables the rapid deployment of new services. The TMN is conceptually a separate network for managing and maintaining one or more telecommunications networks.

One of the problems of developing recommendations on architecture is that all telecommunications networks are different, owing to the way in which they have evolved. Therefore, any recommendations on architecture need to encompass all the variations, and there is much debate in the standards-making process to ensure that the views of representatives of all networks are incorporated.

## Networks

ISDNs are, in general, evolving from public switched telephone networks (PSTNs), and are essentially circuit-switched 64 kbit/s networks with common-channel signalling (CCITT Signalling System No. 7) and a message-based customer-access signalling system. Since the transmission path is digital, ISDNs are ideally suited to the transport of data, and give a much higher data rate than with modems on the PSTN, despite significant progress in the development of modems. It was intended that ISDNs would also provide a packet bearer capability, and it was considered by some that ISDNs would replace packet networks. Recent developments suggest that it is more likely that the provision of packet services on ISDNs will be by giving access to dedicated packet networks. This too may not happen in many countries owing to the development of frame mode (frame switching and

---

Note that, since this article was written, the International Telecommunications Union (ITU) has reorganised and the work previously done by the CCITT is now the responsibility of the ITU-TS (International Telecommunications Union—Telecommunications Standardisation Sector).

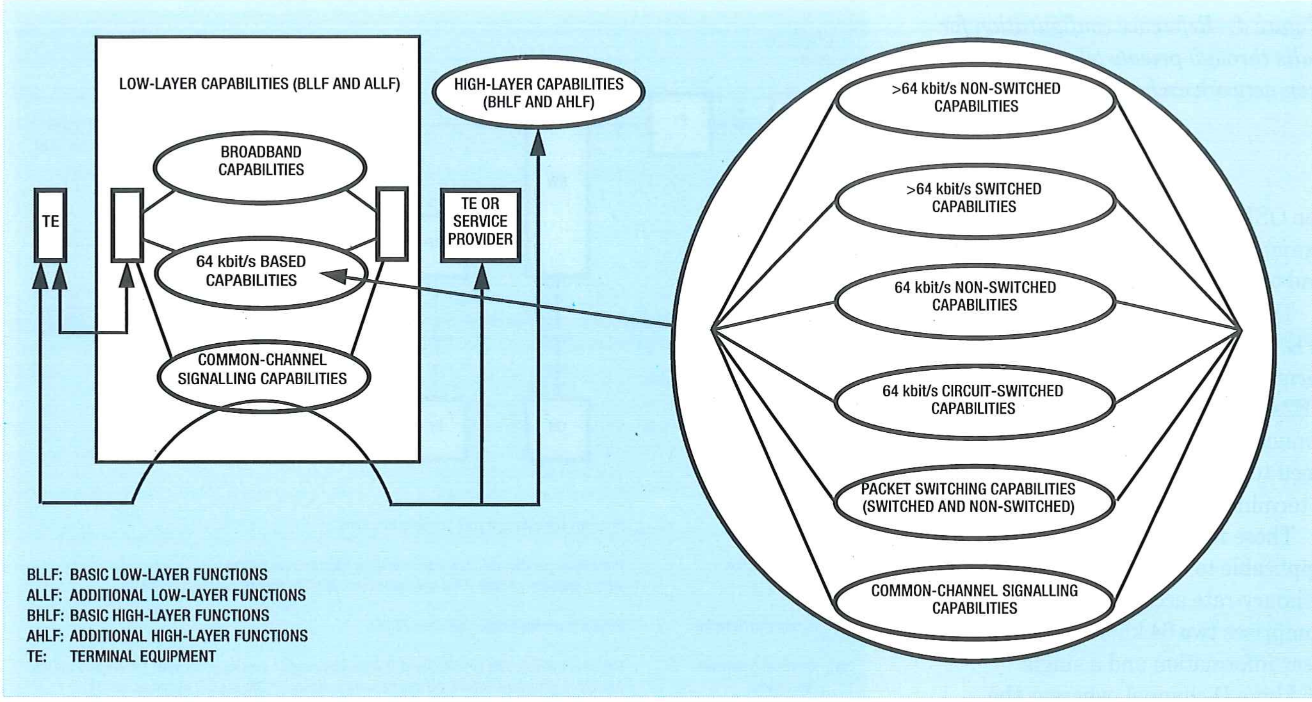



*Figure 1—Basic architectural model of an ISDN including B-ISDN*

frame relaying) bearer services. Frame mode is related to packet switching, but uses less complex protocols which improves the transmission rate since less of the potential transmission capacity is lost in overhead (error checking and correcting mechanisms). This is possible because modern networks have a much better error performance than the networks for which packet switching was designed.

Because it seems that it is unlikely that ISDNs will replace existing packet networks due to the existing investment in packet networks, the devising of mechanisms to facilitate interworking between ISDNs and packet networks has absorbed much effort in standards bodies.

## Reference Configurations

Figure 1 merges the basic architectural models of an ISDN and B-ISDN (from I.324 'ISDN Network Architecture' and I.327 'B-ISDN Functional Architecture'). The basic and additional lower-layer functions (BLLFs and ALLFs) shown in the figure are described in Recommendation I.210 'Principles of Telecommunication Services and the means to describe them'. In essence, BLLFs relate to layers 1 to 3 of the Open Systems Interconnection (OSI) model (described in recommendation X.200) and support bearer services and teleservices, whilst ALLFs are the additional functions necessary for the support of supplementary services.

### Reference configurations for the ISDN user-network interface

The ISDN user-network interface recommendations apply to physical interfaces at reference points S and T. This is shown in Figure 2 (from Recommendation I.411). Reference points are conceptual points dividing functional groups. In a specific access arrangement, a reference point may correspond to a physical interface between pieces of equipment, or there may not be any physical interface corresponding to the reference point.) At reference point R, physical interfaces in accordance with existing CCITT Recommendations (for example, X- and V-series) or physical interfaces not included in CCITT recommendations may be used.

The NT1 functional group includes functions broadly equivalent to layer 1 (physical) of the OSI reference model. These functions are associated with the proper physical and electromagnetic termination of the network. NT1 functions are: line transmission termination; timing; power transfer; layer 1 multiplexing; and interface termination, including multidrop termination employing layer 1 contention resolution. NT2 functions are equivalent to layer 1 and above of

*Figure 2—Reference configurations for the ISDN user–network interfaces*

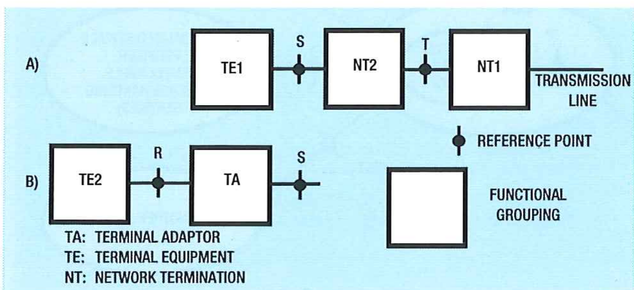



*Figure 3—Reference configurations for the B-ISDN user–network interfaces*

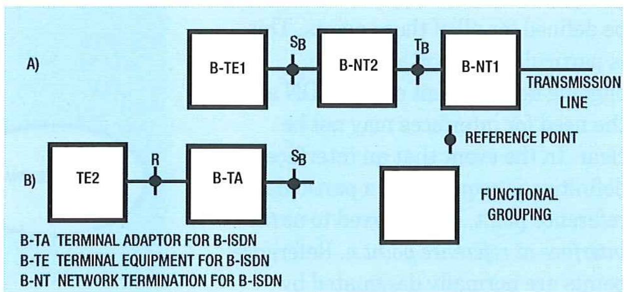
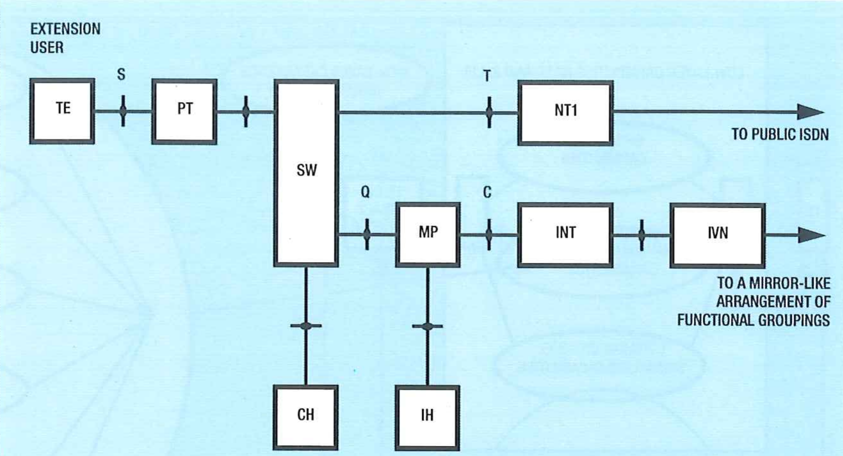


*Figure 4—Reference configuration for calls through private telecommunication network exchanges*




**FUNCTIONAL GROUPINGS**

| | | |
|---|---|---|
| CH | Call Handling | Provides signalling and call handling functions. |
| IH | Interconnection Handling | Provides signalling and connection handling functions for the control, where possible, of inter-PTNX connections provided by the IVN functional grouping. |
| IVN | Intervening Network | Supports communication between PTNXs. |
| INT | Intervening Network Termination | Provides transmission functions and, if applicable, layer 1 functions between the MP and the IVN functional groupings. Where the real network is a public ISDN, the INT becomes an NT1. |
| MP | Mapping | Provides the functions necessary for mapping of user and signalling information. |
| PT | Private Network Termination | Provides transmission functions and, if applicable, layer 1 signalling functions. |
| SW | Switching | Provides switching functions for user and signalling information. |

PTNX: PRIVATE TELECOMMUNICATION NETWORK EXCHANGE

the OSI reference model. Typical examples of NT2s are PABXs, LANs and terminal controllers.

Two types of terminal equipment (TE) have been identified. TE1s are terminals designed for ISDNs, whilst TE2s are terminals designed for connection to other interfaces and need to be connected to the ISDN via a terminal adaptor (TA).

These reference configurations are applicable to both the basic-rate and primary-rate accesses. The former comprises two 64 kbit/s B-channels for user information and a single 16 kbit/s D-channel, whereas the latter comprises 30 B-channels and one 64 kbit/s D-channel.

The reference configuration defined for ISDN in I.411 for ISDN basic- and primary-rate accesses were considered general enough to be applicable to all aspects of the B-ISDN accesses, and equivalent reference configurations were produced in I.413 (see Figure 3).

## Reference configuration for calls through private telecommunication network exchanges

While private networks are outside the scope of this article, the reference configuration shown in Figure 4 (from ENV 41004) is presented to show how the relationship with the public network is seen from the perspective of the private network.

## Interfaces and reference points

It was explained above that reference points are conceptual points dividing functional groups. Reference points are useful in that they can be used to separate the different functional groups, but do not require interfaces to be defined for all of these points. This is particularly important in the ongoing development of the ISDN as the need for interfaces may not be clear. In the event that an interface definition is required, at a particular reference point, it is referred to as *the interface at reference point n.* Reference points are normally designated by capital letters. Figure 5, from I.324 'ISDN Network Architecture', shows these reference points. It will be seen from the figure that reference points can be within an ISDN, such as the P reference point to a specialised network resource (for example, a database), or without as in the case of S/T, $K_X$, M and $N_X$. Note that the suffix can take the value 1 or 2, where 1 indicates that interworking functions exist inside the ISDN, whilst 2 indicates that no interworking functions are required in the ISDN. It should be noted that, in the case of interworking between ISDN and PSTN, reference point K would in most cases be embedded within the combined ISDN/PSTN (see later under 'Network and Service Interworking'). In today's terminology, the M reference point would be between an ISDN and the supplier of value-added network services. Whilst the concept of reference points was developed as part of ISDN architecture, it has also been taken up in the separate development of architectures for private networks and the telecommunications management network (TMN). Unfortunately, this separate development has resulted in the use of 'Q' to denote

*Figure 5—Reference points for interconnection of customer equipment and networks to an ISDN*

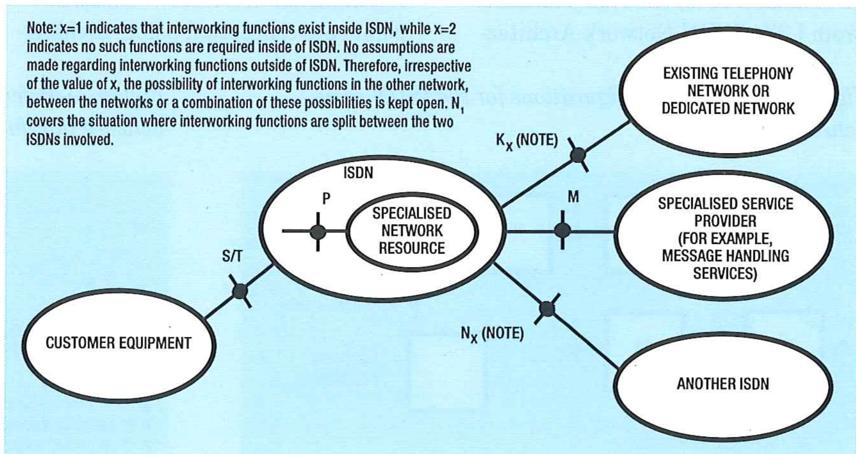
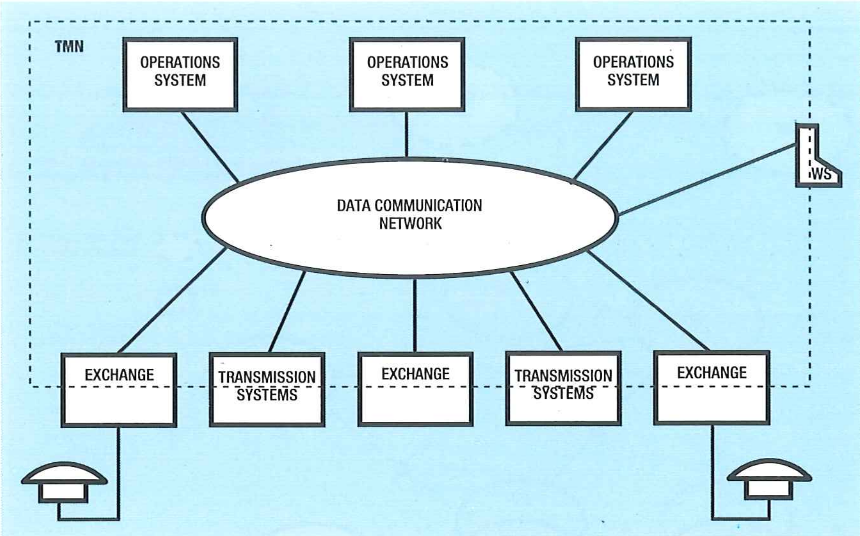


Figure 6—General relationship of a TMN to a telecommunications network




different reference points in both private networks and the TMN.

## The Passive Bus and Terminal Selection

At an early stage of the development of ISDN standards, the *passive bus* was devised (see Annex A of I.430). It was considered that a small business would probably wish to attach a number of terminals to the two B-channels without additional switching. Terminals could include one or more telephones, facsimile machines and computers. Only one ISDN number may be used for both B-channels, in which case additional signalling information is needed to identify the correct terminal. The SETUP message of the ISDN customer access signalling (that is, the one which is used by the calling customer to convey the requirements of a given call to the network and sent by the network to the called party) contains, in addition to both calling and called party numbers a number of information elements to aid in the selection of the correct terminal. These elements are bearer capability (BC), low-layer compatibility (LLC) and high-layer compatibility (HLC), and will be described in a later article.

When the signalling system was initially designed, in parallel with the concepts, structure and services of the ISDN, the precise way in which these elements would be used was not clear. Subsequently, an attempt was made to clarify this, and a recommendation was developed describing terminal selection (I.333), which was first published in 1988 and has now been further refined. This recommendation is primarily aimed at terminal manufacturers, but has significance to the network provider, in that if the ISDN customer gets numerous calls to the wrong terminal, it is the network provider who is most likely to get the blame (that is, it is perceived as poor quality of service). It also considers calls from the PSTN since the PSTN customer does not have the ability to give any selection information other than the ISDN number and there is no way of indicating whether a call from the PSTN is a voice or data call. The supplementary service 'Multiple Subscriber Number' can be used to allocate several numbers to a given ISDN access, but it is then necessary to program the numbers into the terminals.

## Telecommunications Management Network (TMN)

A TMN is conceptually a separate network that interfaces with one (or more) telecommunications network(s) at several points in order to receive information from it and to control its operations. A TMN may use part of the telecommunications network it is interfaced with to provide its own communications. Figure 6 illustrates the relationship between a TMN and a telecommunications network.

### Background to TMN

As the number and variety of telecommunications networks and services have grown, so has the diversity of management needs. In the past, these have been satisfied by manufacturer or network operator specific solutions. This has resulted in a proliferation of 'one off' management solutions which have made it difficult to manage services and networks supported by different manufacturers' network equipment. It has also severely restricted the ability of network and service providers to exchange information in an electronic form.

It was realised that the whole telecommunications industry would benefit from one set of standards which would permit interoperability between a broad range of network equipment and management systems whilst allowing operators the freedom to adopt various implementation strategies. Network and service providers also realised that they would benefit from the ability to exchange information electronically to provide services such as 'one stop shopping' and global managed networks. As a consequence, the CCITT started work on the TMN around 1986 and began the development of a series of recommendations which, in turn, draw on the OSI systems management services and protocols. These recommendations define the TMN architecture, functional groups and reference points, but the TMN does not affect the ISDN architecture, and so it is not appropriate to this article to give more details. The reader is referred to the CCITT M.1000 series of recommendations.

## Intelligent Network

### Background

The development of standards for the IN was initiated in both the European Telecommunications Standards Institute (ETSI) and CCITT in 1988 as a result of a number of different drivers from both network operators and manufacturers. The main objectives were to produce a set of standards that would lead to a flexible network platform that would:

- support the rapid deployment of new services without having to redefine and modify the basic network infrastructure (adding new functionality and modifying signalling protocols and software in a service specific manner); and

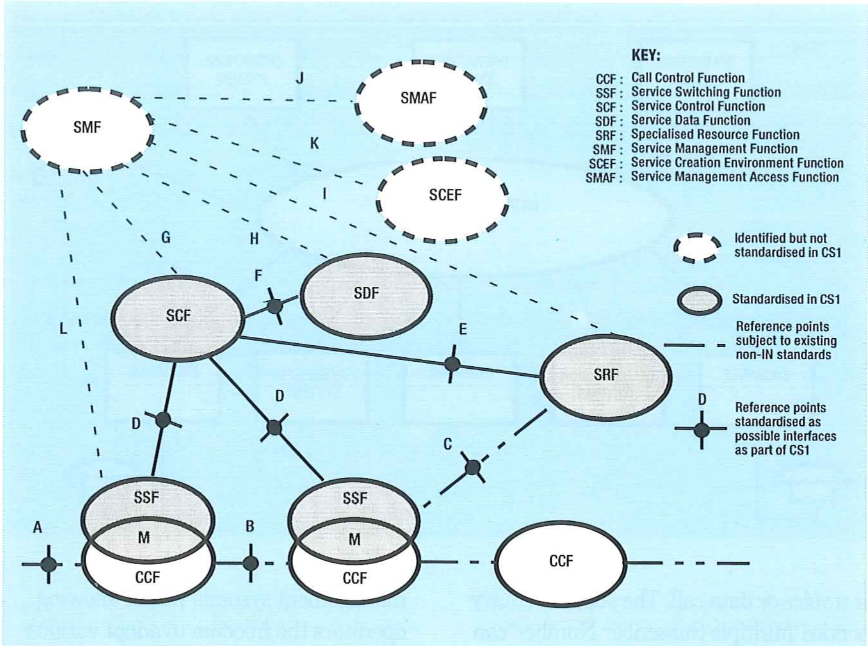



*Figure 7—IN functional architecture (based upon CCITT Recommendation Q.1211)*

- lead to the availability of interoperable network equipment from more than one manufacturer.

Initial discussions in both organisations resulted in some basic but fundamental agreements that have been embodied in the set of IN standards, known as *Capability Set 1* (CS1), to be published in the CCITT Q.1200 series of recommendations during 1993. It is intended to produce initial Capability Set 2 standards by 1994. The salient features of the IN may be summarized as follows:

- the IN represents a network architectural concept; that is, not a new network;
- it is service independent; that is, the design is not based upon a predefined set of services; and
- it provides the definition of new internal network interfaces.

This new approach requires a radical departure from the service driven approach used to develop ISDN standards to date.

## The IN conceptual model (INCM)

The INCM was developed within CCITT as a tool to determine the physical network architecture based upon the types of services to be supported. It describes the relationships between the services provided by the IN, the related network functions and the resulting functional architecture, leading to the physical network architecture. It is structured as four planes: the service plane, the global function plane, the distributed function plane and the physical plane. Further discussion of this model is outside the scope of this article, its importance being in the development of the functional and physical architectures described below.

## The distributed functional plane—IN functional architecture

The IN functional architecture represents the key to the flexibility offered by the IN and that developed for CS1 is shown in Figure 7. The important elements are:

- the *call control function* (CCF) which encompasses the basic call and service processing functions that already exist within the network. The IN is not attempting to change existing standards in this area;
- the *service switching function* (SSF) which represents the necessary 'trigger' functions that need to be added to the existing call processing algorithms in order to invoke the new IN functionality;
- the *service control function* (SCF) which denotes the control functions required for the provision of IN type services;
- the *service data function* (SDF) which represents the data required by the SCF for service control; and
- the *specialised resource function* (SRF) which represents the functions required to interact with the user, such as the collection of digits, and tones and announcements.

The reference points A, B and C translate to physical interfaces that are already defined in non-IN standards. Reference point A equates to the user–network interface, B to an internodal signalling interface, for example CCITT Signalling System No. 7 (SS No. 7), whilst C could be either supported using SS No. 7 or user–network signalling.

The reference points D, E and F have been defined as possible interfaces within the IN physical plane in terms of the SS No. 7 intelligent network application protocol (INAP) and supporting SS No. 7 protocols. The INAP supports the requirements of all three interfaces and represents the major deliverable from the IN standards activity to date.

Reference points G to L together with the service management function (SMF), service management access function (SMAF) and service creation environment function (SCEF) are outside the scope of the CS1 standards; they are likely to be standardised within future capability sets (CS2, CS3...).

## IN physical architecture

The IN concept will allow manufacturers to build equipment that performs more than one IN function (for example, a combined SCF and SDF). In this case the necessary interaction between the functions will be internal to the equipment and there is no need to make use of the INAP. The interaction with other IN functions, or combined functions (for example, SCF

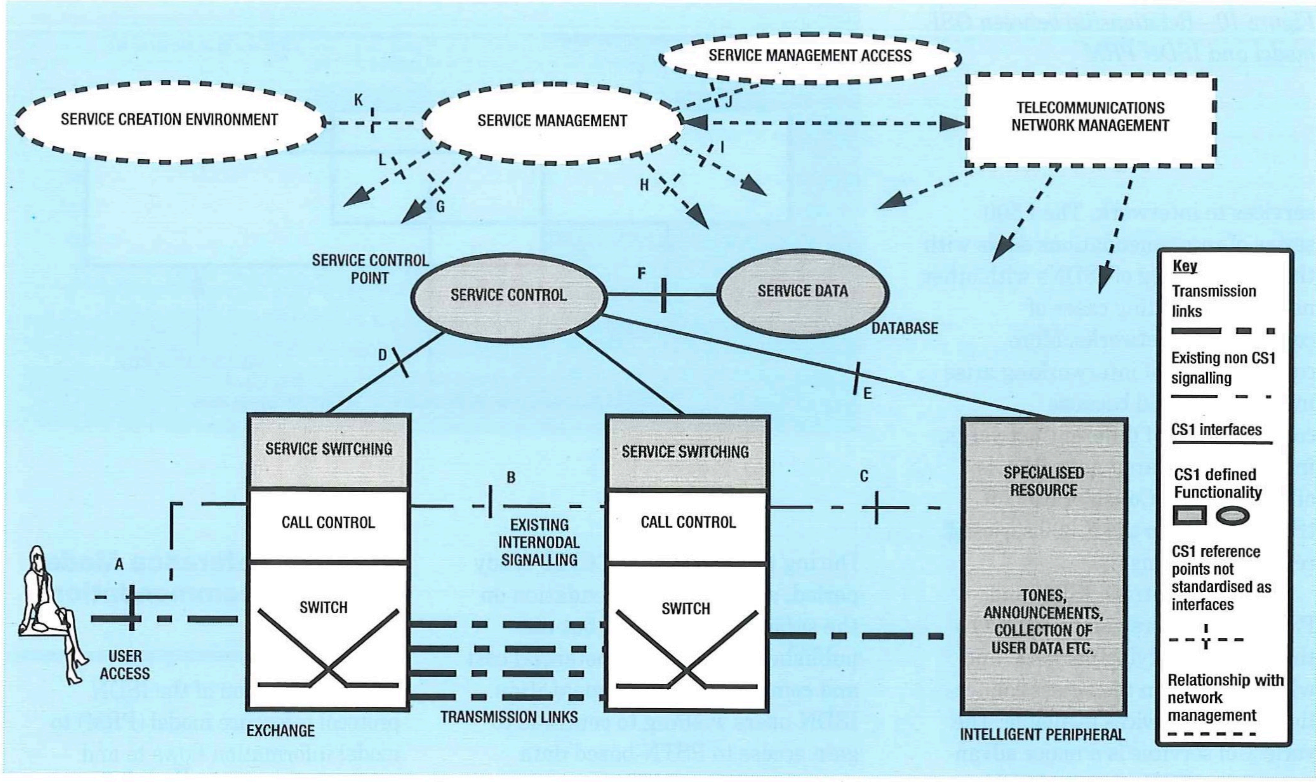



*Figure 8—Example IN CS1 physical architecture—employing all CS1 interfaces (D, E and F)*

to a second SDF) would, however, need to make use of the INAP.

The interfaces that are implemented in real networks will depend upon the available products from manufacturers and the requirements of individual operators. It is quite possible that some implementations will not realise any of the IN interfaces and provide the IN functions within single physical entities; that is, a conventional exchange! Figure 8 shows a physical architecture employing all of the CS1 defined interfaces.

## Numbering Standards

Worldwide telephone communications are facilitated by the international agreement to the use of the CCITT E.164 numbering plan for the ISDN and PSTN. Initially, the ISDN numbering plan (E.164) was an extension of the telephone numbering plan (E.163), but E.164 has now subsumed E.163. The most important parts of E.164 are the standardisation of country codes and number lengths. Country codes vary from 1 to 3 digits; national destination codes are typically 1 to 4 digits in length, and subscriber numbers typically 4 to 7 digits. For this reason, a maximum length of 12 digits is recommended, excluding any prefix, until time 'T' (see E.165) when the maximum will be increased to 15 digits. (See Figure 9.)

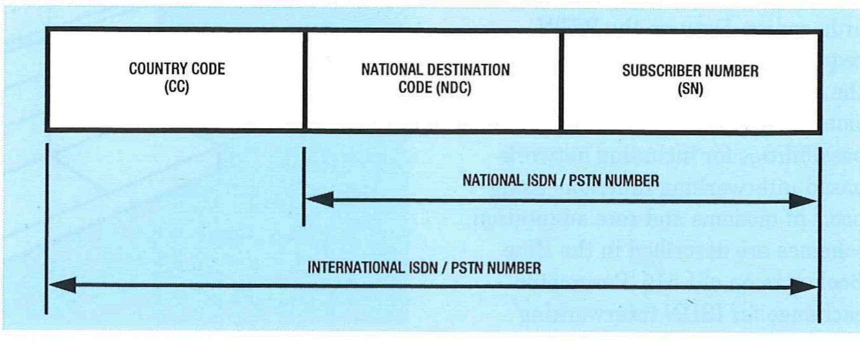
A prefix is an indicator consisting of one or more digits that allows the use of different types of number formats; for example, local, national, or international. Currently, in the UK, the trunk prefix is 0 and the international prefix is 010.

Dedicated data networks (both circuit-switched and packet-switched) have a separate numbering plan (X.121). ISDN, being a digital network is equally suited to both voice and data, and, with the development of the ISDN, thought was given to easing interworking between ISDN and dedicated data networks. Interworking between the ISDN and data network numbering plans involves the use of 'escape codes' (usually 0 or 9) inserted before the number. Whilst this is seemingly simple, other considerations need to be taken into account, such as the field lengths in the signalling systems which convey the numbering and the different methods of establishing calls. The many possibilities are documented in E.166 'Numbering Plan interworking for the E.164 and X.121 numbering plans'.

## Network and Service Interworking

In addition to numbering plan interworking, considerable effort has been spent in devising mechanisms to enable different networks and

*Figure 9—ISDN/PSTN number structure*



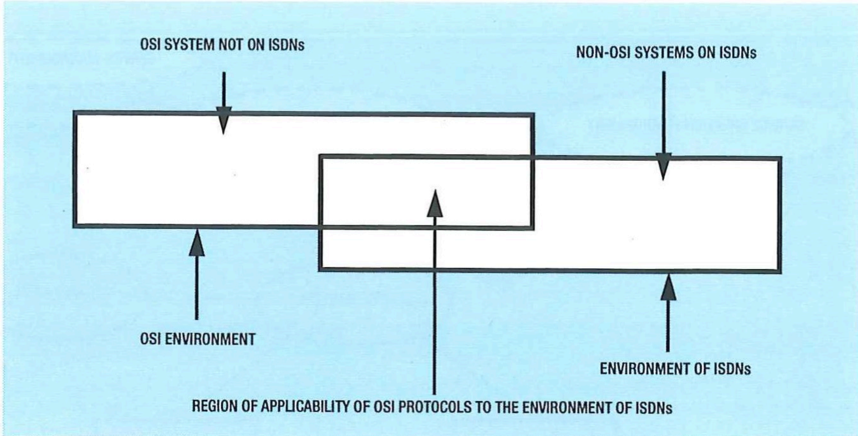



*Figure 10—Relationship between OSI model and ISDN PRM*

services to interwork. The I.500 series of recommendations deals with the interworking of ISDNs with other networks including cases of concatenated networks. More complex cases of interworking arise in the data world because concatenation of different networks, including local area networks, is often involved. Consideration of these is given in the X.300 series of recommendations.

In most countries, ISDN and PSTN subscribers will be served by the same underlying network, and will differ only in the access connection and the services available. The variety of services is a major advantage of the ISDN over the PSTN. There is, however, the possibility of the user of one service wanting to communicate with a user who does not subscribe to that service, but to one which has common features. This is referred to as *service interworking*, described in I.501. A typical example is the user of a videophone needing to talk to someone who only has a 'normal' PSTN telephone, or a basic digital ISDN telephone. Since there is no way of knowing whether a distant user is connected to ISDN or PSTN or what type of terminal is connected, the videophone needs to have the capability to 'fallback' to the capability of a basic digital ISDN telephone, which is inherently able to interwork with a PSTN telephone. This fallback capability has an impact on signalling systems, echo control and encoding algorithms, and references out to the relevant recommendations are given in I.501.

The problem of the transition from PSTN to ISDN for data has been discussed at length in standards bodies. Data on the PSTN requires the use of modems, whilst the ISDN uses 64 kbit/s transmission, which is ideal for data. The possibilities for including network-based interworking functions using pools of modems and rate adaptation schemes are described in the Blue Book version of I.515 'Parameter exchange for ISDN interworking'.

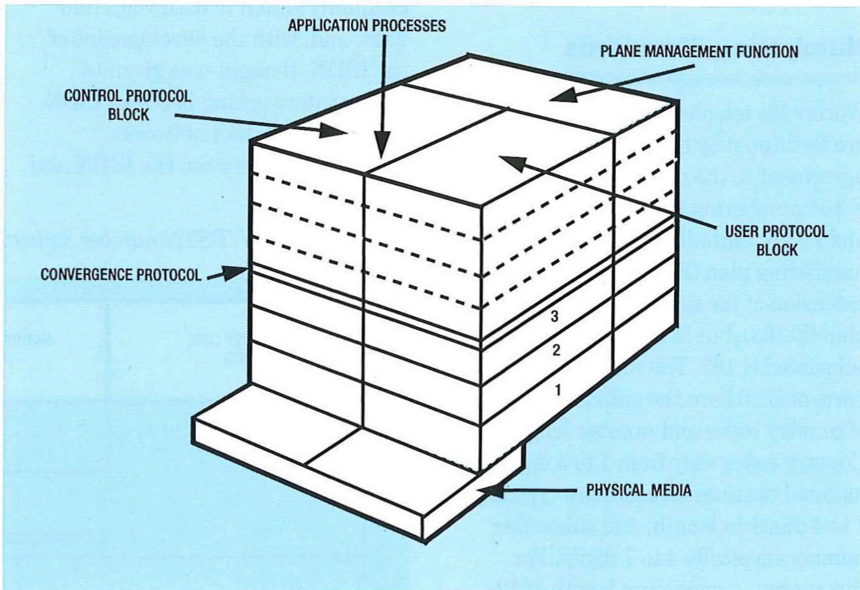
During the 1989–1992 CCITT study period, a whole recommendation on the subject was drafted, but not published owing to the potential cost and complexity of implementation. ISDN users wishing to continue to gain access to PSTN-based data services will have to use a modem and a 3·1 kHz bearer service. In the USA, plug-in cards for personal computers are available which connect to the ISDN and support both 64 kbit/s digital and modem-based transmission. By the use of the fallback capability described above, the service requirements for which are detailed in the multi-use bearer service (I.231.9), the user of such a card will be able to gain access to both ISDN and PSTN data services without the need for complex solutions by the network provider.

## Protocol Reference Model (CCITT Recommendation I.320)

It is the intention of the ISDN protocol reference model (PRM) to model information flows to and through an ISDN. The PRM is layered in a similar fashion to the seven-layer model for OSI, but is specific to ISDNs, whereas the OSI model is intended to encompass any network type, but only for data communications. Therefore, whilst the ISDN PRM has to be equally applicable to voice, video, data and multi-media, the OSI model's relevance to ISDN is in modelling data communications in an ISDN environment. Figure 10, which appears in I.320, depicts this relationship.

Modelling the ISDN along the lines of OSI is difficult because of the

*Figure 11—Generic protocol block*



separation of the signalling (the control plane) from the user transmission channel (the user plane). To support the OSI network layer service over the ISDN a coordination function or convergence protocol needs to operate over the network layers of the B- and D-channels. Linkage between the control and user planes in the ISDN PRM is achieved by the use of the plane management function (see Figure 11). The PRM has recently been enhanced by the introduction of the stratification principle, which models the recursive nature of the support of the service of one network by another network, but which is outside the scope of this article.

## Conclusion

It is hoped that this article has given the reader a useful introduction to, and overview of, the standards related to ISDN architecture. Unfortunately, because of the wide scope of the article, it has not been possible to treat any of the concepts in depth.

## *Acknowledgement*

The author would like to thank Geoff Caryer for his help with the section on TMN and Steve Mecrow with the section on the intelligent network.

## *References*

1 DAVIDSON, P. J. Review of the CCITT Recommendations for Integrated Services Digital Network. *Br. Telecommun. Eng.*, Oct. 1986, **5**, p. 202.

## *Biography*

**Trevor Kent**
**BT Development and Procurement**

Trevor Kent was sponsored as a Post Office Student in 1970. After graduating in 1974, he worked in various aspects of satellite and satellite earth station planning until 1985 when he transferred to work in network standards. Since then, he has represented BT in the CCITT (now ITU-TS) and ETSI, concentrating on standards relating to network interworking and numbering. During the 1989–1992 CCITT study period, he was a rapporteur in Study Group XVIII on ISDN–PSTN interworking and in October of last year took over the chairmanship of ETSI Sub Technical Committee NA2 which is responsible for numbering, routing, interworking and packet and frame mode services.

## *Glossary*

**B-ISDN** Broadband integrated services digital network
**CS1,2** Capability Set 1, 2
**IN** Intelligent network
**INAP** Intelligent network applications protocol
**ISDN** Integrated services digital network
**OSI** Open Systems Interconnection
**PRM** Protocol reference model
**PSTN** Public switched telephone network
**SS No. 7** CCITT Signalling System No. 7
**TA** Terminal adaptor
**TE** Terminal equipment
**TMN** Telecommunications management network

*Sid Russell and Peter Coleman*

# New Road and Street Works Act

*Nearly half of the operational work force are involved in work activities which are affected by the changes in the law relating to works in the street. The environment in which these works are carried out can be extremely hostile and dangerous as well as being highly visible to customers and the public at large. The range of activities extends from simple site surveys through planning, finance, payphones, standard provision and maintenance activities to major civil works by contract. The changes required by the new New Road and Street Works Act and their consequences for BT's business are described in this article.*

## Introduction

More than five years has elapsed from the publication of the *Horne Report* to the start of the implementation of the New Road and Street Works Act (NR&SWA), 1991.

During this time, BT has been actively involved with the Department of Transport, National Joint Utilities Group (NJUG) and the Highway Authority Utilities Committee (HAUC) through expert representation on all the working parties established to draft the regulations and various codes of practice.

The introduction of Parts 3 & 4 (Street Works in England and Wales, and Roadworks in Scotland) of the NR&SWA is welcomed by BT as it clearly defines the national agenda for coordination, technical standards and performance monitoring. The implementation of this Act has provided the stimulus for BT to rationalise its internal working practices and processes UK wide to ensure that operations are effectively coordinated and works are undertaken in a quality manner resulting in the minimum of inconvenience to customers, and the public at large.

To achieve a smooth and professional transition to the new legislation, it has been necessary to employ the tools and techniques of project and process management, to develop all the necessary procedural and technical documentation, and to manage the wide-ranging changes.

## History

The first recorded statutory power was granted to a water company in the 17th century, nearly 200 years before Alexander Bell invented the telephone. However, it was through the development of telephony, gas and electricity that Parliament began to resolve the need for some form of regulation of street works. In 1939, Lord Carnock produced a Government report proposing uniform provisions for all utilities. Work on the report was suspended during the Second World War and it was not until 1950 that the provisions were enacted under the Public Utilities Street Works Act (PUSWA).

Over its 40 year life, the PUSWA has seen many changes in the environment in which it is meant to operate and, in 1983, the Government invited Professor Michael Horne to review street work activities. His report, published in November 1985, contained 73 regulations, some of which were considered as totally unacceptable by the utilities.

As a consequence, the National Joint Utilities Group met with the Highway Authorities and the Department of Transport and, in 1986, a national Highway Authority and Utility Committee was formed. This committee selected experts to help in the production of Regulations and Codes of Practices culminating in the announcement in the Queen's speech to the opening of Parliament in November 1990 to the effect that there would be a bill relating to street works. Royal Assent was granted to the New Roads and Street Works Act, 1991, in June 1991, and the first of the new requirements enacted in August 1992.

## Key Elements

The PUSWA, 1950 was an over-prescriptive statute which did not respond to a changing environment,

*The new legislation introduces a fundamental reform of the system for controlling and executing street works*

and anyone comparing it with the new 1991 Act will quickly recognise a significant improvement in readability coupled with a new flexibility of approach by referring out to the secondary legislation for matters of detail. The new regulations can be easily and quickly amended without the need for Parliamentary time.

The new legislation introduces a fundamental reform of the system for controlling and executing street works, including a simplified system of notices as well as the requirement for street authorities to maintain a register of all works.

In future, all works will have to be carried out by competent people accredited to new prescribed standards. Reinstatements will be carried out by the utilities responsible for the excavations, and works will have to be adequately guarded and lit with properly installed traffic lights, where appropriate.

These new regulations apply to gas, electricity, water, cable TV and BT, as well as anyone else working under licence from the Highway Authority.

The key elements are summarised below:

- Coordination of utility work by Highway Authorities to minimise sequential disruption to highway users.

- Controlled rights of access to certain streets through a new designation system based on traffic flows.

- Statutory power to Highway Authorities to impose a 12 month restriction where street works or resurfacing have been completed.

- A noticing system that dispenses with plans and sections for most types of works and reduces timescales where notices are served.

- New reinstatement standards for backfill materials leading to a two or three year quality guarantee.

- Highway Authority inspections of utility work with failures subject to additional more costly inspections.

- Formal accreditation for operatives and supervisors so that people understand and know what they are doing when working in the highway.

- Signing and guarding requirements that are more demanding than the specification laid out in BT's original *Engineering Safety Guide No. 5*.

- For diversionary works, both the authority and the utility must agree the level of activity necessary to direct the works, coordinate the work, agree any subsequent changes and share costs.

- A requirement on street authorities to maintain a register of detailed information on streets and works carried out in them.

## Coordination

The primary aim of the new act is to put in place a structure and process of coordination between those who carry out street works and those who are responsible for providing and maintaining highways. The act imposes a duty on the Highway Authority to use their best endeavours to coordinate street works, and on the utilities to cooperate in the interests of safety, minimisation of disruption and protection of the highway infrastructure.

The importance of coordination is such that a separate code of practice entitled *Coordination of Streetworks and Works for Road Purposes and Related Matters* has been produced to reduce:

- the level of disruption to road users,

- the number of occasion where undertakers carry out works in a newly resurfaced roads, and

- the number of occasions where one undertaker works in a street only to be followed by another within a short time.

This coordination will be achieved by the implementation of structured HAUCs at local, regional and national levels replacing the existing *ad hoc* arrangements.

## Street designations

The Act prescribes a new set of criteria for designating streets that restricts the automatic right of utility access to existing plant and the ability to enhance it. This means a change to current working practices in the way that they are planned and the times that they are undertaken. In particular, these designations affect the ability to access plant for simple surveying and for repair activities to restore service. In addition to these restrictions, the Highway Authority now has a statutory power to impose a 12 month embargo on utility works where significant street reconstruction work has just taken place.

The designation falls into three specific categories:

- *Protected streets*
  These include streets serving 'strategic major traffic'; motorways, for instance, are presently designated as such. Very tight restrictions on the placing of plant apply in these streets. Existing streets may be subject to the procedure; in this circumstance, any removal of plant which may be necessary will be at the cost of the local authority.

- *Traffic sensitive routes*
  Under the new Code of Practice, streets may be designated as 'traffic sensitive routes' by the Highway Authority. The times when works can be done on these routes will be defined and will be subject to the relevant noticing procedures. It is likely that not more than 10% of streets will be designated 'traffic sensitive routes'.

*Failure to comply with the new regulations will result in severe financial penalties by way of fines*

- *Streets with special engineering difficulties*
  These are streets where structures, for example, bridges, are involved. In such cases, plans and sections will continue to be required. All operations are subject to a noticing period which may be up to three months.

## Notices

This is one of the most complex and far reaching changes in legislation. Professor Horne concluded that 'The PUSWA notices procedures are cumbersome, unsatisfactory and not appropriate to the current levels of street works activity', and that the noticing procedures are a root cause of conflict between the utilities and the Highway Authorities.

A Code of Practice details the new requirements that include a revised categorisation of all types of work (see Table 1). Under PUSWA, it had become common practice in BT to carry out standard restoration of service under the 'emergency' procedure.

This is no longer acceptable and the new 'emergency' categorisation is severely restricted and will only allow access to certain streets in matters of life and death. Failure to comply with the new regulations will result in severe financial penalties by way of fines.

## Categories of work

### *Emergency works*

Emergency Works are defined in the Act as those 'whose execution at the time when they are executed is required in order to put an end to, or to prevent the occurrence of, circumstances then existing or imminent (or which the person responsible for the works believes on reasonable grounds to be existing or imminent) which are likely to cause danger to persons or property'. The term also includes works which, though not falling within that definition, cannot be separated from it, such as street works not at the emergency site necessary to shut off or divert a supply.

Remedial works to dangerous defective reinstatements are emergency works. The key change for BT is that the onus of proving the existence of an emergency always lies with the undertakers, and failure to provide evidence will result in fixed financial penalties.

**Table 1 Minimum Notice Periods**

| | Minimum Notice Period | |
|---|---|---|
| **Categories of Works** | **Non Traffic-Sensitive Situations** | **Traffic-Sensitive Situations** |
| Emergency | Within 2 hours of work starting | |
| Urgent | Within 2 hours of work starting | 2 hours notice in advance |
| Special cases of urgent works | Within 2 hours of work starting (where immediate start is justified) | |
| Minor works (without excavation) | Notice not required | 3 days notice |
| Minor works (with excavation | Notify by daily whereabouts | One months advance notice and 7 days notice of start date |
| Standard works | 7 days notice | One months advance notice and 7 days notice of start of work |
| Major projects | One months notice and 7 days notice of start date | |

*Notes:*
1. *Reinstatement*: whether or not a notice is required, the Street Authority (in Scotland, the Road Works Authority) must be informed of the completion of reinstatement before the end of the next working day.
2. *Streets of special engineering difficulty and protected streets*: approval for works in such streets must be obtained from the relevant authority separate from, and in addition to, the formal notice.

### *Urgent works*

Urgent works fall short of emergency works as defined in the Act, but are of sufficient urgency to warrant immediate action either to prevent further deterioration of an existing situation or to avoid an undertaker becoming in breach of a statutory obligation. For example, to:

- prevent or put to an end an unplanned interruption of any supply of service provided by the undertaker;
- avoid substantial loss to the undertaker in relation to an existing service; or
- reconnect supplies or services where the undertaker would be under a civil or criminal liability if the reconnection is delayed until after the expiration of the normal notice period; and
- include works which cannot reasonably be severed from such works.

This category of work will include the majority of the major service failures in BT's access network.

*utilities are responsible for carrying out all their own reinstatements and guaranteeing these for two to three years*

***Special Cases of Urgent Works***
Special cases of urgent works are those which are required, or are believed to be necessary, for restoring or preventing an interruption in a supply or service to premises where:

- the undertaker and the street authority have agreed in advance that immediate action may be taken in the event of a loss of service occurring or threatening (for example, hospitals, old peoples' homes, stock exchange or dealers' premises, banks, police stations, premises with telephone alarm systems, commercial and industrial premises reliant upon continuous supplies etc.); or

- the undertaker fears that an emergency situation may develop if immediate action is not taken and considers that the need for such action outweighs the danger of traffic disruption.

***Minor works***
Minor works are those that do not fall into the above categories and are:

- not of a planned duration of more than three days, and

- not part of a rolling programme, and

- not planned to involve at any one time more than 30 m of works and to leave less than the minimum width of carriageway necessary for one-way traffic.

***Standard works***
Standard works encompass all other works not detailed in the annual programme. These include resurfacing works in excess of 20 m$^2$, and where an undertaker returns to site after interim reinstatement to complete such permanent reinstatement.

***Major projects***
Major projects are 'standard works' which have been identified specifically in the undertaker's annual operating programme or which, if not specifically identified in that programme, are normally planned at least six months in advance of works commencing.

The period of notice required depends on the category of work and the likely effect of the work on traffic flows. Unlike PUSWA, the notice requirements are weighted, so that longer periods of notice are required for larger-scale works and for those which are planned to take place during traffic-sensitive times. Furthermore, most works which are minor works, taking place in non-traffic-sensitive situations, will require no prior notice at all.

## Reinstatements

The quality of reinstatement was a key trigger to the Government promoted inquiry into street works, and Professor Horne concluded that there were serious weaknesses in the materials and methods used in reinstatement, and he recommended that a 'New national specification should be drawn up to replace the existing ones on materials and workmanship involved in excavations coupled to an entirely new type of specification on the standard of performance that should be achieved by reinstatements after completion. This standard reinstatement performance specification should ensure that the road is restored to a satisfactory standard of riding quality. In cases where an immediate permanent reinstatement is not possible or desirable, an interim performance specification should apply, which would be aimed primarily at ensuring that the safety of all classes of road user is fully protected'.

The HAUC accepted these recommendations in full and produced a detailed specification containing in excess of 1000 menu options. BT was instrumental in designing the specification which has become the definitive Code of Practice on Reinstatements.

Again, the key element for BT is that, under the legislation, utilities are responsible for carrying out all their own reinstatements and guaranteeing these for two to three years depending upon the depth of excavation. It is anticipated that the new specification will reduce the risk of failures where the workmanship and materials are to the new higher standards.

Should remedial work become necessary within the guarantee period because of a failure, the guarantee period commences from the date of the completion remedial work. There is also an increased failure cost where remedial work is found to be necessary. In such circumstances, the Highway Authority has the power to compel the utility to undertake remedial work and to pay the enhanced costs of subsequent inspections. Exceptionally, the Highways Authority could also initiate prosecutions which could result in heavy fines to BT regardless of whoever is doing the work on its behalf.

## Inspections

The Highway Authority has statutory powers to carry out objective inspections of work at any time during excavation and reinstatement and during the guarantee period.

During these inspections, which will take place without prior notice, the Highway Authority's representatives will have the right to inspect the work, including signing and guarding standards, materials quality and handling, reinstatement workmanship and generally satisfy themselves that the work complies with the prescribed standards.

Utilities will be required to contribute towards the cost of these inspection visits based on a nationally-agreed flat-rate fee per visit and for up to 6% of visits during excavation, up to 6% of visits during reinstatement, up to 6% of visits to reinstatements within three months of completion, up to 6% of visits 6–9 months after completion and up to 6% of visits in the three months prior to

the expiration of the guarantee periods. The flat rate fee per visit for 1993 is £12·50.

Where, as the result of a visit, the Highway Authority identifies a defect, the utility concerned is required to remedy the situation within prescribed timescales. The Highway Authority can, in the case of reinstatement failures, carry out up to three additional site visits for which they can recover inspection costs based on twice the flat-rate fee per visit. Failure to carry out the remedial action prescribed could lead to the Highway Authority having the work done, recovering the costs from the offending utility and imposing heavy statutory fines—so it is vital that BT gets it right first time, every time.

## Accreditation

Of primary concern to all utilities and contractors working on their behalf are the legal requirements contained in Section 67 of the Act (Section 126 in Scotland). This requires those operatives who tunnel or bore under, excavate or open the road or street to hold a prescribed qualification for the work being undertaken. There is also a requirement that on such works, the responsible supervisor must hold a similar prescribed supervisory qualification, although the Act clearly states that the supervisor need not be on site.

Qualifications are to be awarded by the City and Guilds of London Institute and the Scottish Vocational Education Council based on evidence of successful assessment. In order to gain the accreditation for operatives, the various skills employed and knowledge required in excavation and reinstatement have been grouped into a number of discrete units of accreditation. These units of accreditation combine to form the qualifications to be awarded. An example of this for operatives is shown in Table 2 and a similar example for supervisors is shown in Table 3.

The Act requires that for street works involving breaking up the street, the supervisor is to become

**Table 2 Units of Accreditation for Operatives**

The knowledge required and skills involved in carrying out excavation and reinstatement of the road or street form Units of Accreditation.

| | |
|---|---|
| Unit 1: | Location and avoidance of underground apparatus. |
| Unit 2: | Signing, lighting and guarding. |
| Unit 3: | Excavation in the highway. |
| Unit 4: | Reinstatement and compaction of backfill materials. |
| Unit 5: | Reinstatement of sub-base and roadbase in non-bituminous materials. |
| Unit 6: | Reinstatement in cold-lay bituminous materials. |
| Unit 7: | Reinstatement in hot-lay bituminous materials. |
| Unit 8: | Reinstatement for concrete slabs. |
| Unit 9: | Reinstatement of modular surfaces. |

**Qualifications for Operatives**

Units of Accreditation above combine into qualifications.

| | |
|---|---|
| Qualification 1: | Excavation in the highway<br>Units 1, 2, 3. |
| Qualification 2: | Excavation, backfilling and reinstatement of construction layers with a cold-lay bituminous surface<br>Units 1, 2, 3, 4, 5, 6. |
| Qualification 3: | Reinstatement of construction layers in hot-lay and cold-lay bituminous material<br>Units 1, 2, 6, 7. |
| Qualification 4: | Reinstatement of concrete slabs<br>Units 1, 2, 8. |
| Qualification 5: | Reinstatement of modular surfaces<br>Units 1, 2, 9. |

**Table 3 Units of Accreditation for Supervisors**

The knowledge required and skills involved in monitoring excavation and reinstatement of the road or street form Units of Accreditation.

| | |
|---|---|
| Unit 1: | Location and avoidance of underground apparatus. |
| Unit 10: | Monitoring signing, lighting and guarding. |
| Unit 11: | Monitoring excavation in the highway. |
| Unit 12: | Monitoring reinstatement and compaction of backfill materials. |
| Unit 13: | Monitoring reinstatement of sub-base and roadbase in non-bituminous materials. |
| Unit 14: | Monitoring reinstatement of bituminous materials. |
| Unit 15: | Monitoring reinstatement of concrete slabs. |
| Unit 16: | Monitoring reinstatement of modular surfaces and concrete footways. |

**Qualifications for Supervisors**

Units of Accreditation above combine into qualifications. To be awarded a qualification it is necessary to demonstrate successful assessment in these units.

| | |
|---|---|
| Qualification 6: | Monitoring excavation in the highway<br>Units 1, 10, 11. |
| Qualification 7: | Monitoring excavation, backfilling and reinstatement of non-bituminous materials<br>Units 1, 10, 11, 12, 13, 14. |
| Qualification 8: | Monitoring reinstatement of bituminous materials<br>Units 1, 10, 14. |
| Qualification 9: | Monitoring reinstatement of concrete slabs<br>Units 1, 10, 15. |
| Qualification 10: | Monitoring reinstatement of modular surfaces and concrete footways<br>Units 1, 10, 16. |

qualified by July 1994, and an operative is to be qualified by July 1997.

Where a road or street is opened but the surface is not broken up (for example, a joint box or manhole cover), no qualified supervisor is required for the work. An operative at the work site need only hold a Record of Achievement in Signing, Lighting and Guarding (Unit 2 in Table 2).

The Act makes no mention of training, although most people who require to be qualified are likely to need some training in order to reach the standard for successful assessment.

Training can be delivered in a number of ways including conventional training courses. However, to minimise the total cost of training and assessment, a computer-based distance-learning package has been developed by BT Training to deliver to a number of accreditation units close to the workplace.

### Signing and guarding

The *Horne Report* was the most critical of the standards and practices relating to signing and guarding. It appears that few in the utilities industry realise that signing and guarding provide safety for the working parties as well as for the travelling public. There is clear evidence that despite detailed briefings, instructions and documentation, few working parties sign and guard the work site adequately. Previous legislation allowed few people to enforce the requisite standards, but the new legislation provides the opportunity for anyone to initiate criminal and civil proceedings against individuals and/or companies.

Furthermore, a new code of practice has been produced that defines how work sites are to be laid out and specifies the design, size and reflectivity of the signs, guards and associated equipment.

BT's safety policy is contained in the *Engineering Safety Guide No. 5* and the consequences of the new legislation have been that the Guide has been totally revised, and all signs, guards, barriers, most high-visibility jerkins and cones are having to be replaced by April 1995. In addition, there is a requirement to provide on-site details of who to contact in an emergency; this will be managed by the provision of information boards to a prescribed design and size.

All people in BT who use signing and guarding equipment must be assessed and obtain a record of achievement in Unit 2 (Signing, lighting and guarding) and it is imperative that standards in what is an everyday activity are revised significantly.

### Diversionary works

The Code of Practice has been designed to encourage Local Authorities to look closely at the impact of road works upon utilities and to discourage them carrying out diversions unless absolutely necessary. The new code is based on four principles:

- Plant should not be moved unless necessary.
- Cost should be minimised whoever pays.
- The process is carried out to a standard procedure.
- If agreement cannot be reached on any job, the issue must be subject to conciliation and arbitration procedure.

Where diversionary works are unavoidable, new rules will apply regarding both the management and financing of such schemes.

The Highway Authorities have the perception that utilities overcharge, whereas the utilities believe the converse. To satisfy all parties, it has become a requirement that these schemes must be subject to formal documented procedures. There must be immediate discussion in the case of deviations from agreed proposals, and full visibility of all recoverable costs. For BT, this has meant a detailed revision of all existing procedures, and the creation of a new end-to-end documented procedure. This procedure now captures all costs incurred by BT in carrying out works, including those activities done off-site; for example, cost relating to exchange people who carry out planned diversions of dedicated routes and circuits.

The new financial arrangements also include the principle of cost sharing between the highway, bridge or transport authority and BT where BT's plant is affected. The promoting authority will pay 82% of the actual costs and BT will contribute the remaining 18%. If the diversionary works are to take less than three months, then 75% of the 82% should be paid as a lump sum before the works begin. If the works are longer than three months, then the payments will be in agreed instalments while the BT works are being carried out, and subject to a final invoicing process. This arrangement is only applicable to works promoted and underwritten by the Highway Authorities, whereas works generated by third parties (for example, superstore developers) are subject to full recovery of the costs by the utility.

## Computerised Street and Road Works Register

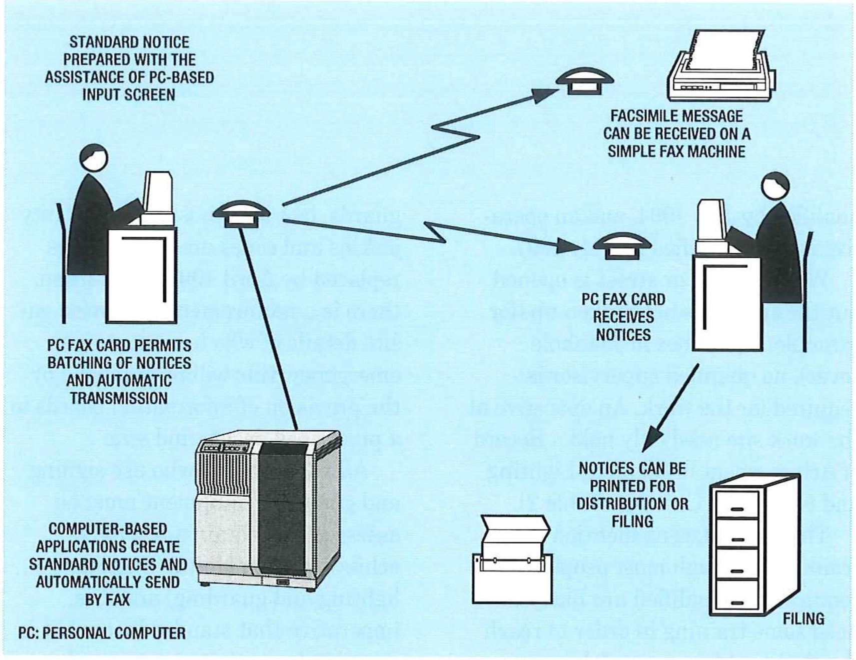
The activities of coordination, classification of works, notification and registration of reinstatements involve a high volume of information to be exchanged and made available to all those who need to be informed of any particular works being carried out.

Firstly, the works must be categorised to determine the type of notice required as detailed earlier.

The second step is for the undertaker to give the appropriate notice to the street authority. The purpose of this is to enable the street authority to coordinate the works with regard to other works or traffic flows and to facilitate its street work inspections.

After the notice period has elapsed and if the street authority does not request any alterations to the

Figure 1—PC-based system




proposals, the work can be carried out. If reinstatement is involved, the final step in the procedure is to register the reinstatement measurements with the street authority within seven days of completion.

The practicalities of managing these complex and interrelated tasks led the HAUC working party to conclude that the Horne recommendations for a street works register could best be satisfied by a national system in the form of a Computerised Street and Road Works Register (CSRWR).

A full national computerised system is still a long way off and it is anticipated that a contract for the initial first phase of implementation will be let in July 1993 with a start date of July 1994 and a roll-out nationally within two years. The first-phase implementation will be a computerised record of street works at all stages, from initial notice to final maintenance of the reinstatement.

Later phases will introduce coordination of works and the planning of inspections.

## Interim Register Systems

The relevant codes of practice were drafted based on the expectation that a computerised system would be available upon enactment of the legislation. However, due to the delay in the construction of such a system, considerable effort and debate have gone into setting up local interim solutions involving fax machines, discrete and networked personal computers (PCs) and extended use of existing systems such as *Susiephone*, all based on a standard notice format. While such solutions appear necessary, their development and implementation have to be undertaken in an environment of uncertainty as all systems will need to be either integrated or replaced when the national computerised system is fully introduced.

With this in mind, a stand-alone PC-based solution has been made available (see Figure 1) using software available from the consultants involved with the logical design of the CSRWR. In addition, London is using its existing PC network based civil engineering management system CAVALIER* to trial an alternative solution.

This will enable BT to move quickly to a computer-supported facsimile method of sending notices whilst keeping a register of all our works which can readily be downloaded to a central system at a later date.

## Implementation

### Initial project development

It was evident from the Horne Report that significant changes in the law were both necessary and inevitable and that such changes would have a major impact upon a broad cross-section of the business.

Key people from within BT, led by Bill Linskey of the Government Relations Department, were involved in every facet of the proposed legislation to ensure that BT's interests were safeguarded and that the final regulations were acceptable to the utilities and the Highway Authorities. The negotiations and consultations involved a large number of vested interests linked into the Department of Transport, which was developing the legal framework (see Figure 2).

In the summer of 1991, once there was a clear understanding of the broad principles of the new legislation, BT decided to manage the change as a specific project using current project management techniques. Furthermore, as the major impact of the changes would be on access network activities, the ownership of the project was placed with Personal Communications Division.

Once the client requirement definition and the project requirement definition had been agreed with the process owners in Personal Communications and Worldwide Networks, a project control board was set up with representatives from all parts of the business affected by the changes. The project was broken down into a number of work packages (see Figure 3), which were linked to an implementation plan that also detailed all the milestones required to achieve a successful implementation.

Throughout the implementation of the plan, difficulties were experienced due to continual uncertainty about timings of enactment and the final details of the legislation. In addition, the complexity of the changes required were consistently underestimated by the promoters of the legislation. This, together with the inability of such a large number of key players to reach a consensus on what should form the basis of the

* CAVALIER—Contract allocation via local independent estimate recording

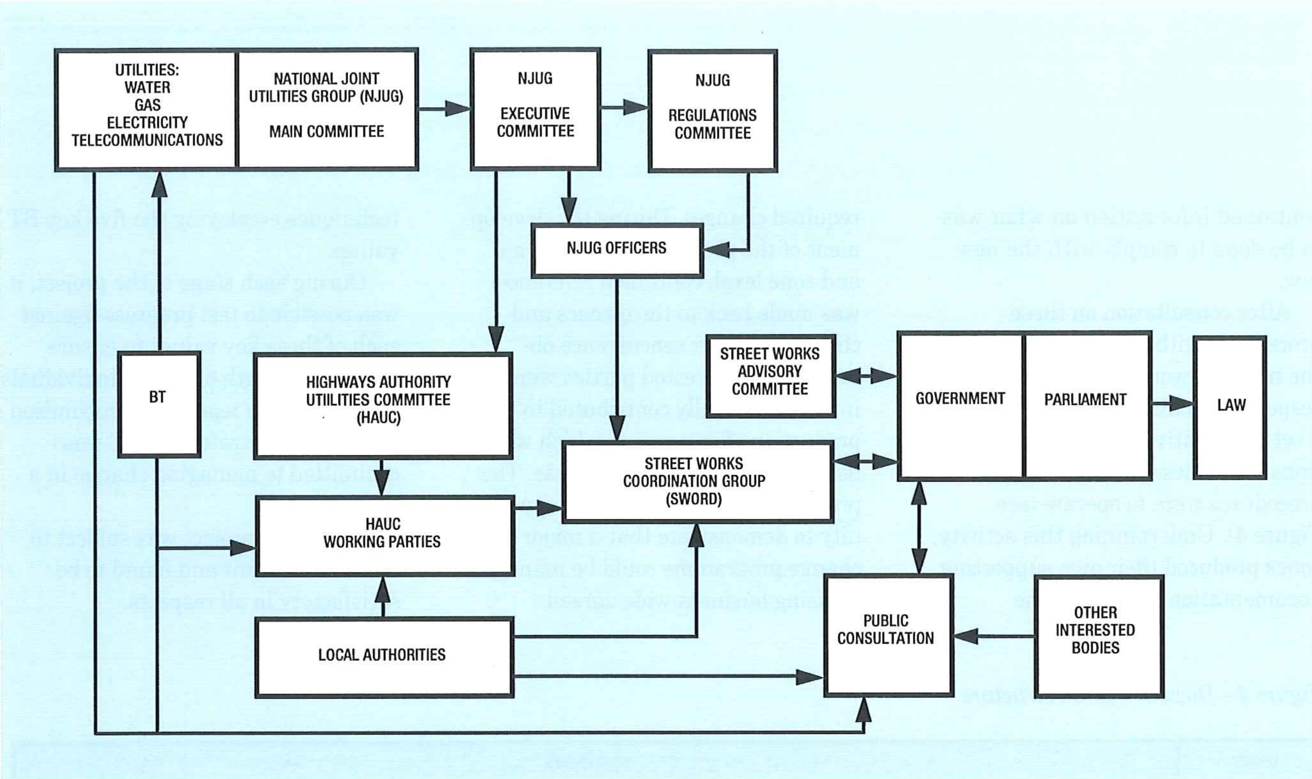



*Figure 2—Negotiation and consultation process*

regulation and how the Act would operate through its Code of Practice, also created unnecessary problems. As a result, the implementation was successively delayed from an original date of October 1991 to January 1993.

## Project plan

A project plan was issued to General Managers and key players in June 1992, promoting the creation of zonal implementation teams which were to be structured in a similar manner to the national project control board; that is, by creating work packages based on a new set of procedures produced by members of the national work package teams. These procedural documents

*Figure 3—Work packages*

| WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|
| GOVERNMENT RELATIONS DEPARTMENT | WORLDWIDE NETWORKS | PERSONAL COMMUNICATIONS POLICY | STRUCTURE AND ORGANISATION | SUPPORT FUNCTIONS (EXCLUDING WORLDWIDE NETWORKS) | TRAINING | PERSONAL COMMUNICATIONS PAYPHONES |
| INTERPRETATION OF LEGISLATION (PRIMARY AND SECONDARY) | REVISION OF PLANNING RULES | EXCAVATION AND REINSTATEMENT: DIRECT LABOUR, CONTRACTORS | WORKS SUPERVISION | CONTRACT DESIGN | REQUIRED BY LEGISLATION | CIVIL ENGINEERING AND OPERATIONAL PAYPHONES ACTIVITY |
| | TECHNICAL SPECIFICATION: SAFETY AND GUARDING EQUIPMENT | NEGOTIATIONS: HAUCs | EXTERNAL WORKS | INDUSTRIAL RELATIONS | BT TRAINING COURSE REVISION | |
| | TECHNICAL SPECIFICATION COMPUTERISED STREET AND ROAD WORKS REGISTER | OTHER TOPICS AS GENERATED DURING PROJECT | PLANNING PROCEDURES | FINANCIAL AND BILLING PROCEDURES | ZONE DATA ON GRADES AND NUMBERS | |
| | COMPUTING HARDWARE, SOFTWARE | | EWC FUNCTIONING | | TRAINING OVERVIEW | |
| | | | EPMC FUNCTIONING | | | |
| | | | CUSTOMER INSTALLATION AND REPAIR | | | |
| | | | NETWORK MAINTENANCE | | | |

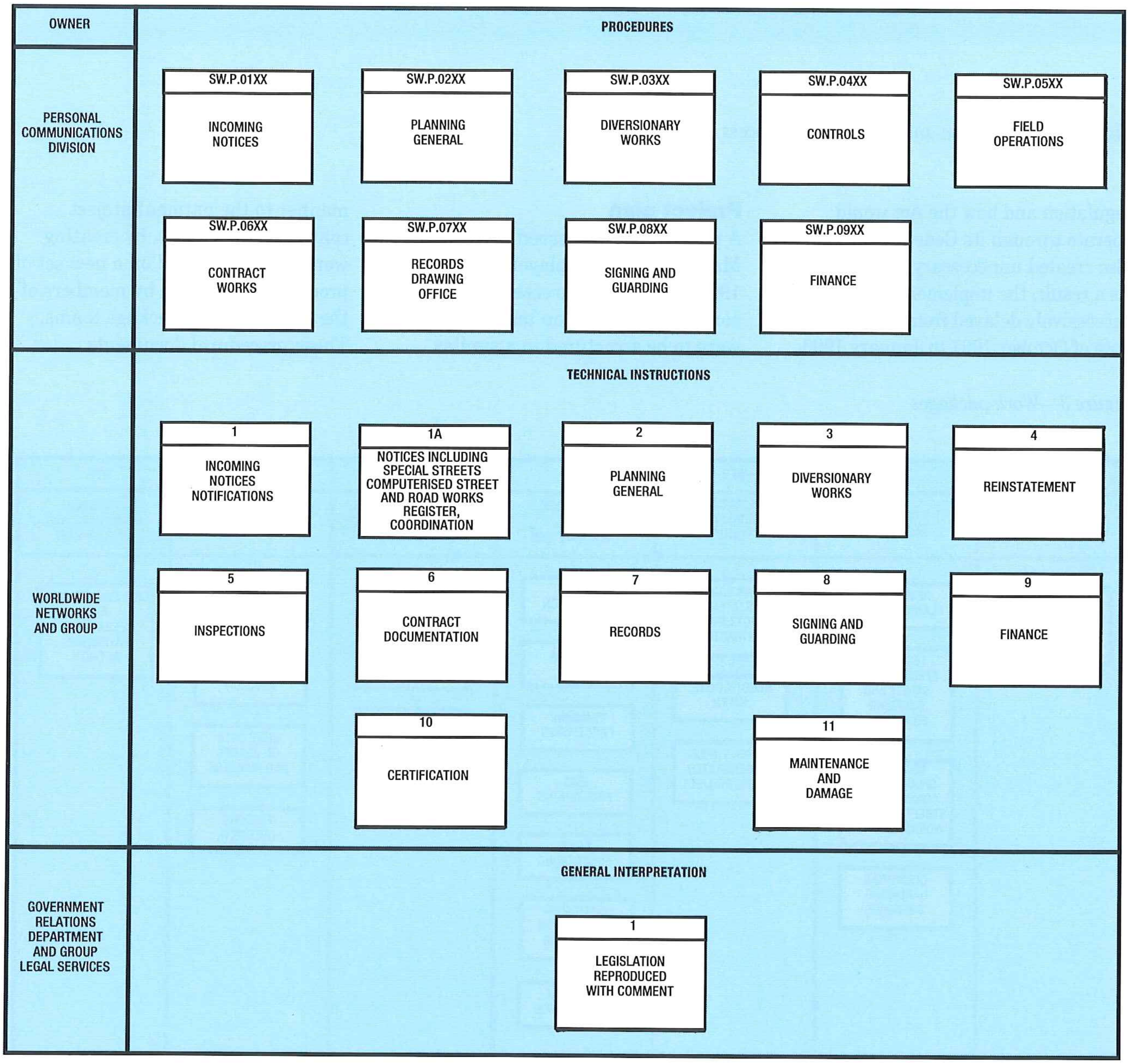
contained information on what was to be done to comply with the new law.

After consultation on these procedures with all interested parties, the national work package team and respective technical authors produced a set of definitive technical instructions which described how the new procedures were to operate (see Figure 4). Underpinning this activity, zones produced their own supporting documentation to manage the required changes. During the development of the project at both national and zone level, continued reference was made back to the owners and clients and their concurrence obtained. All interested parties were involved and fully contributed to the production of documents which were both professional and fit for use. The project provided an excellent opportunity to demonstrate that a major change programme could be managed by using business-wide agreed techniques employing the five key BT values.

During each stage of the project, it was possible to test progress against each of these key values to ensure that the strength of all the individuals involved in the teams was maximised and to demonstrate that BT was committed to managing change in a quality way.

The entire project was subject to an internal audit and found to be satisfactory in all respects.

*Figure 4—Documentation structure*



*The new legislation has created a year of major change in organisational structures, skills and operating standards*

## Looking to the Future

The new legislation has created a year of major change in organisational structures, skills and operating standards.

Already there have been changes to the regulations, and it is likely that there will be further and continual changes to the Secondary Legislation resulting from shortcomings in the current documents. Furthermore, there are sections of the NR&SWA that are still to be fully implemented, and other sections, including those relating to rental for occupation of road space, for which any detailed proposals have yet to be discussed and formulated. BT cannot expect to enjoy the benefits of a period of stable legislation and must therefore ensure that processes and procedures are in place to manage the legislative changes. While the appropriate tools are available, there is always a risk that the organisation will change such that the ownership of managing the changes becomes unclear.

BT will take full advantage of the knowledge gained during this project to meet the challenges of the future created by the regulation as well as those presented by commercial and technological development.

## Conclusion

BT has worked hard to improve and then maintain its reputation in the area of street works and all people involved in the changes can take pride in the achievements to date. BT is 'streets ahead' of many other organisations involved in the new legislation due in no small way to the commitment and enthusiasm of the project control board, zonal implementation teams, work package teams, NJUG and HAUC representatives and everyone who has been affected by these demanding and widespread changes.

The new Act, whilst providing a more suitable platform for monitoring and controlling streetworks than PUSWA, imposes significant changes in standards. These can be addressed only through a more professional approach by all functions at all levels of the business involved in these activities, coupled with a determination that BT is committed to providing top quality services in the public highway.

## *Glossary*

**CSRWR** Computerised Street and Road Works Register
**HAUC** Highway Authority Utilities Committee
**NJUG** National Joint Utilities Group
**NR&SWA** New Road and Street Works Act
**PC** Personal computer
**PUSWA** Public Utilities Street Works Act

## *Biographies*

**Sid Russell**
BT Personal Communications

Sid Russell joined the business, in 1956, in the old South East Area and worked on customer installation and maintenance before moving on to exchange and PABX maintenance. In 1965, he joined the Engineer-in-Chief's Office working on customer equipment development and purchasing, and then spent four years in Africa as a switching expert modernising the junction network. On his return to the UK, Sid worked for a number of years on major assignments to improve efficiency in key operational areas before returning to line management on the formation of Districts in 1986. Since then, he has been responsible for logistics, estate, frames and major projects in the City of London District and, for the last four years, for all external engineering activities in the southern half of the Personal Communications London Zone. In addition to his line responsibilities, he has been leading on the national project for 100% dial tone on housing estates as well as the street works project. He is the executive member of NJUG and HAUC for BT , and chairman of the project control board responsible for the implementation of the NR&SWA.

**Peter Coleman**
BT Personal Communications

Peter Coleman is currently the External Networks Technical Services Manager, Personal Communications Wales and the West. In addition, he is a member of NJUG and deputy chairman of the BT project control board responsible for the implementation of the NR&SWA. Peter joined the GPO as an apprentice in the Cardiff Telephone Area, in 1968, and progressed within the external planning discipline. As a manager, Peter has been responsible for external contracts, project management, drawing offices, external works and maintenance. More recently, he has trained in process consultancy techniques, which are of benefit in the current demanding assignments. Peter is an Incorporated Engineer, a member of the Institution of Electronics and Electrical Incorporated Engineers, and a member of the Institute of Management.

*Tun Chun Nie and Ronald D. Hilton*

# Outsourcing Service and Information Technology Analysis—Part 1

*The fundamental aspect of outsourcing service lies in the application of information technology (IT), which empowers the corporation to gain competitive business advantages. It is increasingly judged upon the criterion of how well it fits into the way an organisation does business. This article, to be published in two parts, examines IT from both business-application and technology perspectives.*

## Introduction

Corporate business trends are increasingly moving towards decentralisation of activities, with sharpened focus on the customer, and diversification of geography to expand the market. These trends demand a fundamental change in the corporate computing and communication infrastructure to move information more cost-effectively. The exploitation of information technology (IT) to demonstrate superior business competence over competitors has become the key corporate strategy of the 1990s.

The pace of technological change within the last decade has been enormous and unprecedented. Examples include:

- the deployment of personal computers (PCs), servers and workstations on local area networks (LANs) as the major corporate information means;
- the availability of intelligent networking equipment with advanced software and communication protocols for carrier and customer premises applications;
- the options of fast packet switching and optical transmission standards for efficient information multiplexing, transport and access; and
- the variety of switched and dedicated services for voice, data and video applications from the carriers.

This rapid technological evolution has placed a formidable challenge on corporations. To comprehend, to plan, to apply and to manage these technologies creatively to solve business problems will incur substantial capital investment. Real expertise is very scarce.

These changes in business trend and technology have caused the corporate decision makers to re-examine the criteria for IT investment. The driving force is the desire to establish a new way of doing business and to make it the primary means of competitive differentiation. The objective is to be more responsive, and to be in a position to offer higher quality, quicker delivery, and expanded capability at lower cost. If one has to make decisions based on past experience, the records of return on investment on IT in an average company have not been impressive. Analysts estimate that in today's corporations only some 2–5% of their information resources can be accessed on-line, and that only about 2–5% of total revenues are spent on their information system (IS) budget. With the existing business infrastructure unchanged, it may require 100% of investment from revenue to automate the enterprise fully.

It is evident that a transformation has to take place in order to alter this traditional intangible return-on-investment equation. The change in attitude of corporations towards IT deployment is manifesting itself in the form of re-evaluating the business infrastructure before the implementation of complex technologies, and becoming more amenable to third-parties for cost-effective solutions. Increasingly, comparing the costs and

*if outsourcing is to fulfil its promise and become capable of providing solutions to empower the business, it must ultimately be whatever the user needs it to be*

capabilities of external expertise versus internal faculties is a mandatory requirment for staffing any new IT project. The corporate challenge of the 1990s is becoming how best to manage the relationships between in-house, outsource and hybrid, instead of focusing on technology implementation alone.

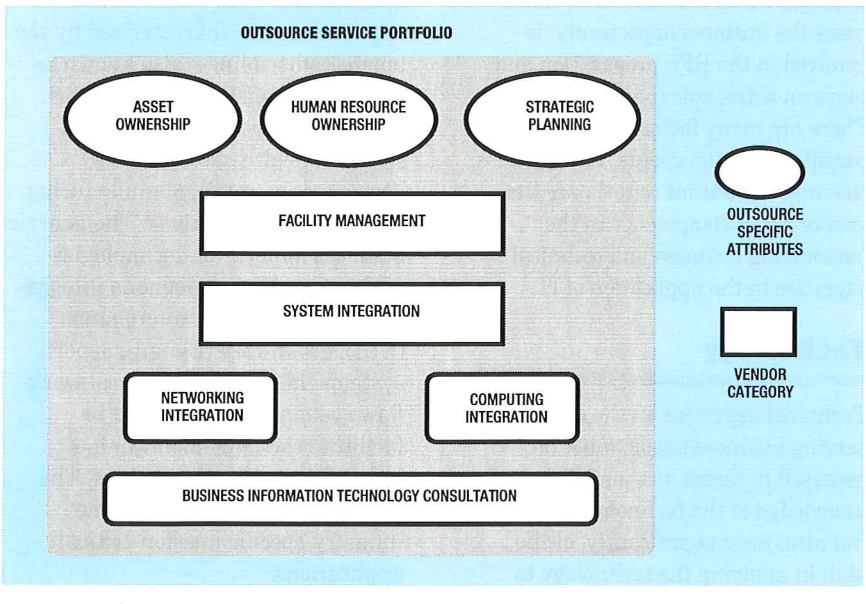
This transformation in corporate IT strategy, in brief, to focus sharply on the objective and structure of the core business, has a significant impact on the corporate computing and communications technologies. This article provides a high-level analysis of outsourcing services and IT applications in business. It also presents an overview of future trends in corporate computing and communication technologies.

## Outsourcing Services

Outsourcing is viewed generically as a third-party solution. It presents many options for the corporate user based on the size of the project, the complexity of the problem, the capabilities each option is offered and the degree of involvement the user is willing to render. In general, the various options based on the present market prospect can be classified as follows:

- *Consulting practice* provides consultation in the areas of technology, specific industry expertise, system management, project management, business-process redesign and information re-engineering. The skills and methodology for the outsourcing evaluation can be considered as a strategic front-end service of this category.
- *Computing integration* implements a processing and database solution by utilising available or purpose-built hardware and software to solve a customer-specified business application problem.
- *Networking integration* implements a communication solution by utilising available or purpose-built networking hardware, software and service to meet a customer-specified network interconnect requirement.
- *System integration* implements a complete system solution by utilising available or purpose-built hardware, software and networking devices to provide a customer-specified business application that may require both computing and communication functions.
- *Facility management* provides operation, management, maintenance and administration of customer's data processing and/or networking facilities. This is also known as *system management service.* Strategy consultation and application integration activities may or may not be part of the contract.
- *Total outsourcing* performs all the above-mentioned activities. It may also encompass the responsibilities of staff transfer, asset acquisition and strategic IT planning that form an integral part of the customer's IS infrastructure and warrant a competitive advantage in the core business.

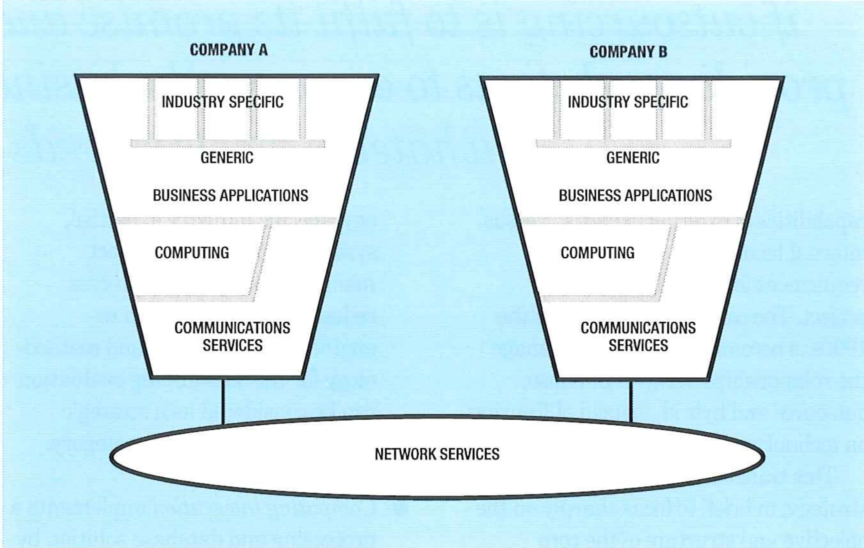
*Figure 1—Outsourcing service portfolio hierarchy*




Every supplier has a different definition of outsourcing. Initially it appears to be confusing, but actually it makes sense when it is realised that if outsourcing is to fulfil its promise and become capable of providing solutions to empower the business, it must ultimately be whatever the user needs it to be. Outsourcing, as used here, is a generic term to describe a composition of all these third-party options. For example, consultation and system integration are just two specific service categories within the outsourcing portfolio. The suppliers who are capable of providing the full range of these service categories are considered to be the total outsourcing vendors. It is important to note that only very few suppliers with broad and well-established worldwide support have the capability of elevating these service offerings to an international level as global total outsourcers.

There exists a clear relationship between these options as depicted in Figure 1. It also implies that there is a strong possibility of progressing from consultation practice through system integration to a total outsource solution. It often makes business sense for both users and suppliers, who may both stand to benefit from this expansion. From a user's perspective, cost remains a primary factor in the decision. As the benchmark methodology matures, the trend is increasingly moving towards

Figure 2—Enterprise information technology high-level model




a piece-by-piece modular outsourcing approach which provides opportunity to switch as well as to evaluate systematically the suppliers for possible future expansion. From a supplier's perspective, increased competition and shrinking profit margin is inspiring them to expand their service portfolio domain.

Product-oriented vendors are capitalising on their equipment/software expertise by offering integration consulting services to offset the price-cut on the products. System integrators are stepping into the IT planning and management consulting practice which extends the relationship with the customer as well as the value of the contract. This continuing phenomenon is shaping the top-tier vendors to become the eventual total outsourcing suppliers. The future of the outsourcing market will be characterised as either the niche player or total outsourcer with very little room in between for other selective third-party suppliers. The niche players will operate as specialised technology subcontractors and commercial industry consultants, which are viewed as an integral part of a total outsourcing solution. The merit of one-stop shopping associated with network services is equally applicable to outsourcing services.

Corporate infrastructure is changing, and IT is moving to the front-line of the organisation as a key component in the execution of business strategy in the search to gain a competitive advantage. From a cost-effective perspective, deploying third-party solutions has become an important part of this strategy implementation. Total outsourcing is regarded as the climax of the third-party solution and the potential benefits are enormous. Economy, technical expertise, access to advanced facilities and flexibility in supporting business-process innovation are the salient advantages. The inherent economy-of-scale that the outsourcer achieves by the combined purchasing power and the ability to spread technology, as well as personnel costs among numerous customers, is the strongest strategic business asset.

A long-term contractual partnership with an outsourcing vendor is a serious business decision that warrants a well-planned evaluation process. Consultation practices to provide evaluation services to companies considering outsourcing are emerging in the industry. A customer will typically take 12 months, from objective setting through working with consultants, to produce a RFP before the vendor evaluation process. It is important that the outsourcer anticipates the business opportunity, is involved in the RFP preparation and plays an active role in the evaluation. There are many factors that may be considered by the clients, nevertheless, the most significant criteria are the vendor's core competency in the outsourcing business and technical expertise in the application of IT.

## Technology

Technical expertise, in the context of serving business needs, must be assessed in terms, not just of the knowledge of the technology alone, but also, most significantly, of the skill in applying the technology to real-world business applications. In a corporate organisation, this is typically fulfilled by the information systems (IS) department, which is responsible for the application of information technology to improve creatively as well as to innovate business operations.

*Technical expertise must be assessed in terms of the skill in applying the technology to real-world business applications.*

Corporate IT can be viewed as consisting of three major technological components, as illustrated in Figure 2. These are: business applications, computing and communications services technologies. The business application technologies comprise industry-specific mission-critical applications and generic applications. These mission-critical applications are characterised by the business disciplines (also known as the *vertical markets*) they support, such as transportation, financial services, health care, utilities, governments, retail, manufacturing and telecommunications. The generic business application technologies such as computer/telephone integration, electronic data interchange (EDI), groupware (E-mail), expert systems, imaging and general workflow systems are often used to facilitate the implementation of industry-specific applications. The following are examples of some industry-specific mission-critical applications:

*The IT application in any business is typically evolving through two major stages: from automation to innovation.*

- American Express (financial service):

  Authorizer's Assistant—a real-time credit authorisation system;

  Credit Assistant—an overdue-accounts handling system;

  New Account Assistant—a credit evaluation system.

- Sears Merchandise Group (retail service):

  Point-of-sale registers;

  Check-approval system;

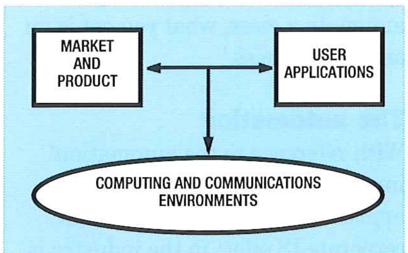
  Credit inquiry system;

  Inventory replenishment system;

  Merchandise assortment/planning system.

Computing and communications are the fundamental underlying technologies used to create these business applications. Mainframe, mini, workstation, personal computer, server, operating system, desktop software, database and various application software-development tools are typical computing technologies. The communications technologies include network elements such as switching, transport and access systems as well as transmission architecture, communication protocol, network services (voice, data and video) and management. All business applications will use some form of computer and/or communications technologies for corporate information processing, storage and interchange in an enterprise environment.

*Figure 3—Enabling technologies evolution*




These fundamental technologies are often referred to as the *enabling technologies*. Business applications are limited only by our imagination in the way businesses can be operated optimally, while the enabling technologies are continuously evolving to improve their capability for a closer physical realisation. The equipment vendors have been able to respond quickly to the corporate transformation from centralisation to distributed applications with powerful workstations, servers, bridges and routers, but, however, the interconnect, transmission capacity and management technologies are still a step behind by comparison. This is implied in Figure 2 by the upside-down pyramid.

Enabling technologies provide incremental capabilities for developing new applications and tend to place new demands and different requirements for network services. The evolution of enabling technologies can be viewed from three perspectives, as illustrated in Figure 3. The users explore the incremental capabilities of enabling technologies in the products to foster new applications to best serve the needs of their business objectives. The market responds with further incremental capabilities or fresh innovative products to further encourage new applications. This phenomenon is also driving the computing and communications technologies to promote standard implementation and interworking of products and applications in an increasingly integrated information media environment with greater functionality and bandwidth.

Although mission-critical applications are very specific to business and industry, a generic methodical approach can be taken to analyse how IT may add value to the business. The following sections provide an overview of the various application phases of IT in the business environment.

## Business Engineering

*Business re-engineering, business re-alignment, business process innovation* and *strategic alignment* are the new terms often used to describe the phenomenal corporate priority trend in the 1990s to ensure that the company's IS goals are in line with business objectives. The role of technology in the business applications field is expanding from the traditional automation function to the innovation for continuous improvement in the way the business operates. Specifically, this translates into not only using IT to improve business activities in terms of speed, accuracy and cost-effectiveness, but also to explore continuously the possibilities for any further improvement in the process that technology can offer. The term *business engineering* is used here to simplify and to consolidate this terminology. In essence, it is defined as the application of IT in the business environment to gain strategic advantages.

IT, from an application perspective, encompasses three fundamental aspects: information technology systems, information process engineering and process re-engineering. Information systems typically focus on technologies and products that help implement a process, while the objective of information engineering is to describe an already conceptualised business process in data-oriented informational terms, such that a system can be constructed to support the new process design. The re-engineering aspect is a continuous activity which strives to align the automated process closer to full support of changing business goals.

In a conventional start-up operation, the process is designed at the outset to define the work-flow and the necessary interactions before investigating enabling technologies. The engineering activity is then performed to organise the functional areas and to define the associated data required to facilitate the automation of that process. Information re-engineering is subsequently applied

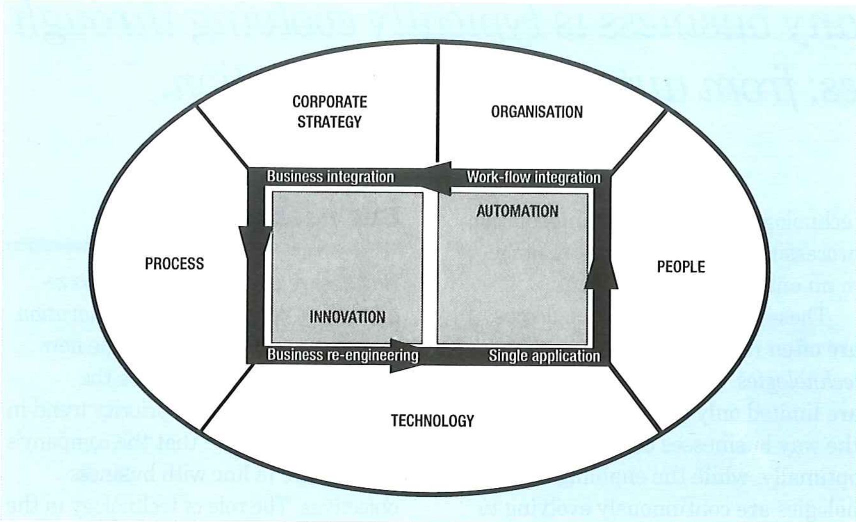



*Figure 4—Corporate strategic units and business automation alignment*

to explore ways to innovate that process on a continuous basis.

The IT application in any business is typically evolving through two major stages: from automation to innovation. The key objective of the first stage is to provide work automation within individual functions of the business and to integrate the flow of the work among the various functional units. It tends to respond to the needs of the business. The goal of the second stage is to consolidate the various functional units in the organisation so that the entire business process can be executed as one single entity. This will require radical changes in the organisational structure as well as the transformation of business process. It tends to add strategic value in the business as a competitive advantage.

The evolution from automation to innovation stage in the business process has an impact on the overall business infrastructure and requires consistent alignment in all five essential elements of the business in order to align the supporting IT with its strategy. As illustrated in Figure 4, the specific implementation steps in the applications of IT in the business may be evolved through:

- single application in a work unit;
- work-flow integration across a functional organisation;
- business process integration across functional organisations; and
- Business process redesign with potential changes in corporate culture, structure and management.

The progression of these stages increases the potential of IT in adding value to the business and permits closer alignment of IT plans with those of the business. It is important to note that the latter two stages are the most significant steps in achieving the highlight of this strategic alignment.

This analysis is consistent with what is taking place in the industry today where the application of computers in the business has evolved from personal to workgroup computing, from isolated islands of technology to integrated systems, and from centralised to distributed client/server enterprise computing.

The heart of business engineering is that a well-automated enterprise can respond to customer requests, process service orders, customise services and develop new products rapidly, thereby leaving behind competitors that are lacking a similar level of automation. Taking the network outsourcing business as a hypothetical case, a simplified view can be established to illustrate the necessary process and automation that might add value to the business.

## The process

A high-level work-flow process is adopted to set a basic framework for establishing the functional areas for automation in the network outsourcing business. The process consists of five major phases as illustrated in Figure 5 and described in Table 1. Each step should be further defined in methodical detail, in terms of functional activities, activities flow, accountability and the required information elements to support the activities.

Corporate milestones are established for each phase with clearly defined criteria for measuring achievement progress and dates for the corporate business plan to drive the project. A formal review is held at the completion of each corporate milestone before progressing onto the next one. This is typically conducted by the senior member of the management team so that risk-taking factors are not necessarily delaying the progress.

The benefits associated with these clearly defined corporate milestone phases lie mainly in the fact that reference points are created to organise company resources efficiently, to flow systematically through the project with increasing measurable confidence and to synchronise effectively the focus of various functional units in the corporation. In essence, it will provide a more coordinated teamwork environment.

The business process presented here is more of a conceptual representation than the actual guidelines to be endorsed and followed. The intention is to make a point on the subject as a reference for the subsequent discussion of automation.

With a clear plan in hand, automation programs may be initiated to engineer the information in terms of data and to implement the activities in terms of systems whenever they are justifiable from a business perspective. Although knowing the technologies is very important, the overall success of this programme lies almost exclusively in the clear understanding of the process to which the automation is to be implemented. Success is going to be judged by the business value it introduces, not by the technology ingenuity it represents. As the saying goes; 'If you automate a mess, what you get is an automated mess.'

## The automation

With reference to the automation/innovation cycle of IT in business applications, much of the present corporate IS effort in the industry is

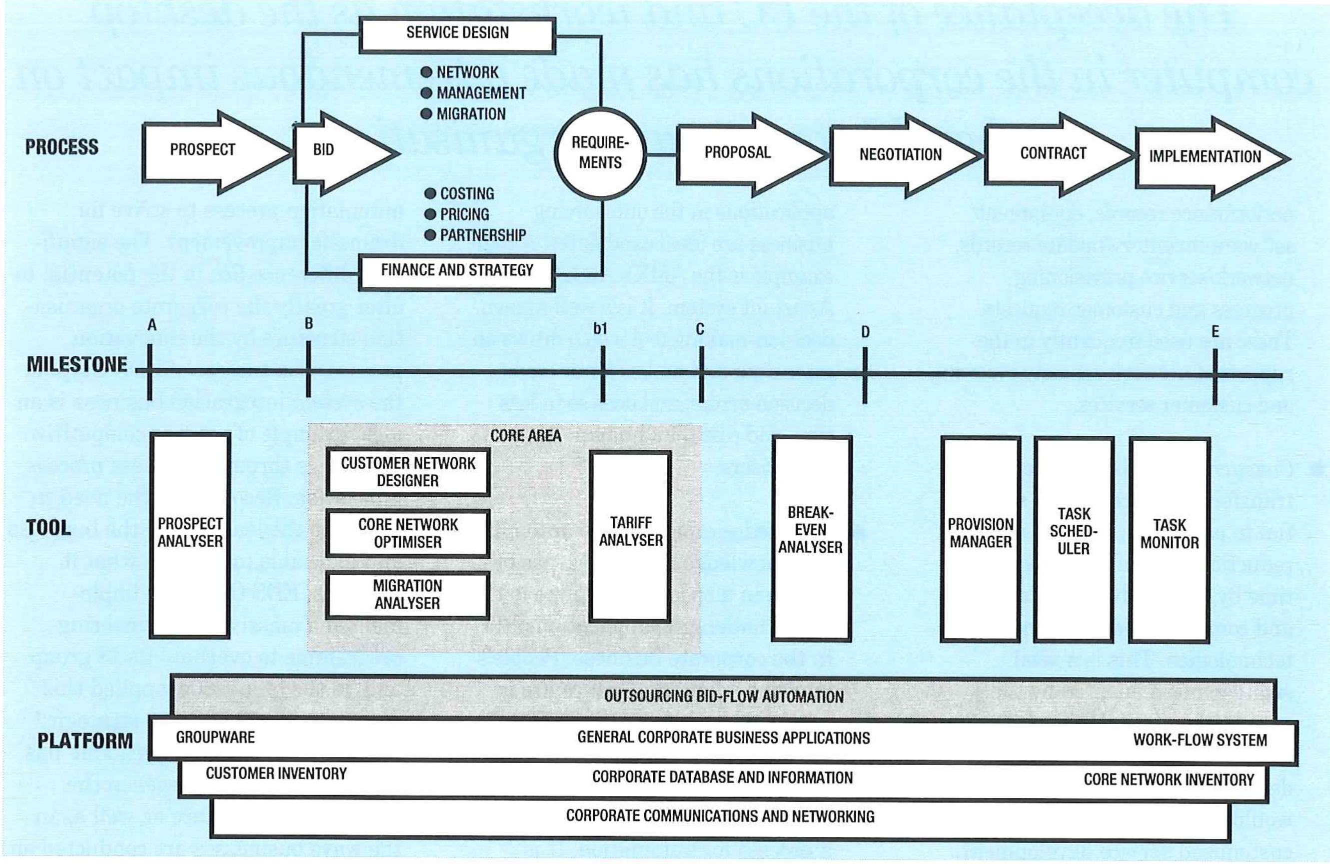



*Figure 5—Outsourcing process and automation*

focused on the automation stage. Increasingly, corporate chief executives are very concerned with the real value of their IT investment, and are demanding an associated boost in profitability. According to a CSC Index survey of over 400 top IS executives from the largest US and European companies with an annual revenue of over $1 billion, about 75% of these companies are either planning or have already initiated effort to innovate their business process with stringent IS requirements to further reduce operating costs or to increase efficiency or both.

**Table 1 Five Major Phases of the Process**

| Milestone | Task | Key Activitiy |
|---|---|---|
| A | Prospect analysis | Profit/loss against ROI activity<br>Risk analysis<br>Resources/technology availability<br>Market/competitors analysis<br>Customer IT strategy analysis<br>Contract potential assessment |
| B | Bid and solution | Management/administration plan<br>Service/engineering solutions<br>Financial/costing/pricing structure<br>Proposal formulation and review |
| C | Proposal and negotiation | Change and impact analysis<br>Bid and proposal review |
| D | Contract | Bid closure and project initiation<br>Closure analysis |
| E | Implementation | Management plan review<br>Ordering<br>Network installation<br>Network control centre/customer service centre implementation<br>Service commissioning |

A very important activity that must be carried out to establish the necessary foundation for this automation initiative is the construction of a corporate data infrastructure. The objective here is to identify, to consolidate and to define the mission critical data as a common corporate asset in a well-organised infrastructure (platform) that can then be distributed, managed and evolved consistently as the business progresses. This data can be used to form corporate information such as sales records, network inventory, customer inventory, carrier tariff, market forecast or customer profile.

Some potential decision-support and design tools are illustrated in Figure 5 in the context of the supporting process and the IT platform. These automated business applications, in general, can be categorised into the following major operational areas:

- *Information collection* Automation can be applied within a process to capture data for producing statistical or performance information which can be used by subsequent analytical functions such as monitoring and control. This data includes traffic usage statistics, tariff, node/link

*The acceptance of the PC and workstation as the desktop computer in the corporations has made a tremendous impact on their IS strategy and organisation.*

performance records, equipment/ software inventory/update records, network/service provisioning progress and customer requests. These are used frequently in the support of network capacity planning and customer services.

- *Concurrency* It is possible to transform a process from sequential to parallel in order to achieve reductions in the process cycle-time by using advanced database and computer-aided engineering technologies. This is a vital strategy often adopted by the competitive product developers in the industry to create a rapid development environment. This would be a good approach for the customised service development.

- *Functions flow* Automation of the manual or labour-intensive work-flow and the production of a more structured process is typically implemented in a service environment, or office in general, where processes are often defined by the flow of documents. In manufacturing business, this is applied in the form of robotics to replace labour-intensive tasks and, at the same time, to increase quality and consistency of the products. An automated work-flow application can be implemented to drive the progression of contract bids. This bid-flow tool can potentially reduce the work-cycle, improve communications and increase quality by adopting technologies such as groupware, LAN-based client/ server computing and imaging.

- *Decision support* A decision-support system automates the various complicated and tedious analytical functions such that sufficient data may be incorporated, and, at the same time, simplifies as well as reduces the time required to perform a decision-making task in a business process. The prospect analysis, resource estimation/reservation and return-on-investment analysis applications in the outsourcing business are ideal candidates. A real example is the AMX's Authorizer's Assistant system. It is a well-known decision-making tool which draws on more data and makes fewer credit decision errors, and does so in less time and cost than human authorisers.

- *Knowledge experience* To automate the knowledge and experience of people in a specific discipline is the most challenging application of IT in the corporate business. People's knowledge and experience are a company's greatest assets. They are difficult to manage, and even tougher to transform these knowledge-intensive activities into a process for automation. It is typically approached by managing these resources: firstly, in terms of acquisition, organisation and deployment; secondly, by instituting a systematic process through which the end-purpose of what this knowledge serves can be derived; and thirdly, by applying technologies and transforming them into an automated system. The core competence of a communications outsourcing business lies heavily in the customer solution design. This type of automation may be applied to this core area including network planning, design and simulation. These tools will optimise the placement of customer service sub-networks on the physical backbone (core) network to meet cost, performance and reliability objectives.

Although the focus here is on the automation phase, this analysis is directly applicable to the innovation aspect. However, the level of expertise required in the business and degree of change in the organisation structure to support the innovated process are much more extensive.

The innovation process can be viewed as a part of the automation process on a continuous basis. It is a corporate initiative to recycle the automation process to strive for dramatic improvement. The significant difference lies in the potential to alter greatly the corporate organisation structure by the innovation process. The success of EDS Corp. in the system integration business is an ideal example of gaining competitive advantage through business process innovation. Recognising the need to maintain the lead-role in the business and to be able to practise what it preaches, EDS Corp. has implemented a massive re-engineering programme to overhaul its IS group and, in the late 1980s, applied this experience to all of its 38 strategic business units. This programme has resulted in major changes in the organisation structure as well as in the ways businesses are conducted on a daily basis in the EDS Corp. today.

In a simple sense, the application of IT in the business involves the transformation of a manual or semi-automated process into a fully automated as well as integrated operation such that further increase in efficiency can be achieved at a lower cost. This directly complements the quality process and yields the consistent results required in a business operation.

For an outsourcer, it is important to have the expertise in analysing the client's business process to explore the potential and to offer plans for automation and innovation. From a business perspective, to be able to deal with the clients at a higher ground has distinct advantages, in terms of profitability and relationship.

## Computing

Sharp reductions in the cost of microprocessors and very large-scale integration (VLSI) technologies have made personal computers (PCs) both powerful and cost-effective. The cost of a PC MIPS (million instructions per second) has fallen from $10 000 to about $400 during the last decade. The acceptance of the PC and workstation as the desktop computer in the corporations has made a tremendous impact on their IS strategy and organisation.

*the conventional scheme of link-capacity over-engineering is no longer a desirable and cost-effective solution in handling the ever increasing LAN internetwork traffic*

These powerful desktops are capable of running advanced personal and business applications formerly performed only by the mainframe or minicomputer in the data centre. The LAN and client/server technologies, the basic building blocks of today's corporate networks, are deployed by the functionally- related work groups to facilitate the interchange of information and to share expensive computing peripheral devices and software. These include printers, file servers, modems, data files and various spreadsheet applications. Electronic mail has also promoted LANs and LAN interworkings in the corporate business environment, thereby enabling organisations to become increasingly automated. These workstations, desktop and LAN-based computing platforms have set the stage for the emerging technologies that will take corporate computing into the year 2000 and beyond.

Server-based databases and groupware applications are taking an ever increasing share of the user's attention, while the importance of mainframe and mini-based applications is diminishing. Even enterprise-wide applications are now being implemented as more flexible and decentralised processes running on powerful workstations connected with LANs that demand ever increasing application distribution and networking capabilities. The development trend in today's corporate computing environment can be best summarised in terms of downsizing the mainframe-based data processing facilities and on-line applications to client/server-oriented LAN-based platforms.

Advanced process distribution approaches are being used wherever a fresh start can be justified, and they are the next step beyond client/server computing. This advanced distribution architecture partitions an application into many software modules that can be run on multiple servers. In this computing environment, the boundary between client and server become more flexible, allowing most software modules to be duplicated and run in both client and server workstations. The proliferation of computing hardware and networking technologies has placed a formidable challenge to the realisation of distributed computing where application software needs to operate across multiple computing platforms which in turn need to communicate through multiple network protocols. A software functionality residing between the application software and the network, called *middleware*, has been identified as the critical technology of the future distributed computing.

The important emerging technologies which will impact most significantly and directly on overall corporate computing capabilities in supporting the core business objectives are: distributed computing, middleware and object orientation of system architecture. These three technologies specify the future of a general corporate computing infrastructure and relate directly to the constructions of computer platform architecture, software development methodology and information organisation.

## Communications

The transformation of the corporate computing paradigm from a mainframe-based host/terminal hierarchy to a LAN-based client/server distributed processing platform has generated a different type of traffic demand on the communications network, both in terms of bandwidth capacity and network utilisation.

In a host and remote terminal access environment, the applications are centrally processed in the mainframe, and the basic information blocks for access transmission are constructed to suit a typical terminal screen orientation of 24 lines × 80 characters that exhibits a relatively low, constant and predictable data traffic demand. The speed requirements, in general, are primarily based on how fast users can type and read.

The traffic for peer interaction of smart devices on a LAN, with client/server applications in a distributed environment, is characterised by the undeterministic data block size and unpredictable frequency of demands. Transferring of files of various programs or data is a typical form of traffic that prescribes the network response-time requirement. Such communication in an enterprise environment, where LAN interconnection through the wide area network (WAN) forms the basic network infrastructure, presents a formidable challenge to the conventional T1-based corporate backbone as well as the existing public carriers' services in the USA.

Traditional time-division multiplex (TDM) circuit-switched T1 multiplexer networks provided fixed capacity allocation for voice, data and LAN traffics on the same transparent bit pipe that simplified the planning efforts due to the deterministic nature of circuit routing and fixed bandwidth allocation. The majority of LAN traffic is typically characterised by the transferring of large application or data files from servers to desktops, followed by sporadic and short bursts of interactive information queries or updates. The mapping of this packet-oriented LAN traffic pattern together with the real-time voice/video traffic onto the same physical T1 transport media poses a relentless and arduous challenge for the corporate network designer. As a result, the conventional scheme of link-capacity over-engineering is no longer a desirable and cost-effective solution in handling the ever increasing LAN internetwork traffic.

It is estimated that by 1995 the internetwork LAN data will account for up to 45% of the overall traffic on the corporate backbone. From a network design perspective, the challenge lies specifically in the juggling for an optimum balance between link efficiency and response time. From a network access perspective, the dynamic nature of today's corporate business both in terms of organisation and market positioning will also require a much more flexible, instant and cost-effective communication access scheme to accommodate the necessary network expansion. Traditional leased-line services with

typical long-lead times no longer provide a sufficient solution.

As the corporate network transforms into an enterprise-wide network, the complexity associated with the technologies, types of network elements, numbers of remote locations and the dynamics of network configuration is increased by a significant proportion. The rising costs associated with the tracking, monitoring, configuring, testing and designing of such a diverse network are a major concern. The costs for the required expertise and technologies to manage the enterprise network are on the increase while the price for transmission lines is decreasing. It is estimated with this continuing trend, the cost of network management will move up to about 50% of the overall corporate communication budget by 1995. Network management has become the primary cost control target.

From the point of view of intricacy of technology, the distribution of applications and information in a multi-protocol, multi-vendor and geographic diverse environment has seriously challenged the philosophy of the once highly regarded centralised 'manager-of-managers' management architecture. The development trend in today's corporate communications is shifting the technology focus towards a more efficient networking approach for LAN internetworking, specifically in the areas of bandwidth-on-demand, network performance and management functionality distribution from the control centre to the LAN administrators at departmental level.

The growing availability of carrier-provided network services is encouraging. These new services are viable, and are economical options for implementing corporate networks. The evolutionary path for the corporate networks of the 1990s has become increasingly a hybrid dichotomy of private and public networking facilities. While most carriers are offering advanced services based on the emerging technologies such as frame relay, switched multi-megabit data service (SMDS), virtual private network (VPN) and switched data services to address LAN, voice, data and video communications in a discrete fashion, some major carriers are vigorously planning to introduce the integrated service platform (voice, data and video) of the future on a global basis.

## Conclusion

The scope of outsourcing services a vendor can provide is related directly to its ability to supply, operate and apply IT to automate as well as to innovate business applications in a corporate environment. As the service level elevates from communication, computing and business applications to IT system/management consultation, its business value to the customer increases. Outsourcing vendors are able to deal with the customers on a higher ground, and command distinct business advantages in terms of extended profitability and relationship.

From a business prospective, the application of IT should be analysed not only in the areas of computing and communication technologies but also, more importantly, in business engineering development. This first part of the article has highlighted the key areas of IT with specific emphasis on the business engineering aspects. The second part (to be published in the October 1993 issue of the *Journal*) will closely examine the evolution of computing and communication technologies in terms of potential impacts in a corporate business environment.

The application of IT to the business environment only makes sense if it adds value to the corporation in terms of the bottom line. Outsourcing makes better sense to customers if it harmonises with their corporate IT strategy. As technology becomes increasingly complex and resource-demanding, outsourcing at all service levels will continue to be a valuable and economical option as part of the corporate IT strategic portfolio.

## *Biographies*

**Tun Chun Nie**
**Syncordia**

Tun Chun Nie is manager for network evolution at Syncordia Corporation. He graduated from University of Essex, England, with a B.Sc. (honours) degree in Electronics Engineering and an associate B.Eng. from Ming-Hsing Engineering College in Taiwan. He has worked for a number of major telecommunications companies in the UK and USA. Prior to joining Syncordia, he worked as a software manager in Bell Northern Research and has led a development group for the network management system. Among other activities, he is currently involved in analysing and consulting strategic approach to corporate IT and network outsourcing.

**Ronald D. Hilton**
**Syncordia**

Ron Hilton is Director of BT Products and Services Management (P&SM) Services Development in North America. His career began in 1970 when he joined Western Electric in Dallas, Texas. After working in the operator services and digital toll switching divisions from 1970–80, he joined AT&T Long Lines responsible for switch maintenance and circuit administration of the 4ESS. In 1983, he joined DSC Communications as Manager of Technical Support for digital switching systems supplied to the new common carrier market: MCI, Sprint, etc. While at DSC, as Director of Technical Marketing Europe, he was seconded to the UK from 1989–91. He joined Syncordia in 1991 as Director Network Evolution to address the emerging multinational customer market with outsourcing solutions. He transferred to his current position in 1992.

*Manuel Avendaño and Peter J. C. Hamelberg*

# A New Cooperative Framework for European Public Network Operators

*A recent development for public network operators as a group has been the creation of the Association of European Public Telecommunications Network Operators (ETNO). ETNO represents the new cooperative framework which enables members to approach each other for the purposes of coordination and cooperation in order to address the different and complex problems that affect them, while at the same time respecting each other's commercial autonomy.*

## Introduction

For many years, telecommunications administrations and, to some extent, operators, industry and other 'players', have cooperated well in the International Telecommunications Union (ITU). This covers regulatory matters, in particular, spectrum management, standards making in the CCITT and CCIR*, including operational cooperation and technical cooperation, mainly directed to developing countries.

In the 1950s, after the Treaty of Rome (1957), there was an increasing need for cooperation on the European level, and this led to the creation of the CEPT (Conference Européenne des Administrations des Postes et des Télécommunications) in 1959.

In most countries in those days, telecommunications operators were government services and therefore administrations at the same time, and if they were formally independent from the State, they were still protected by some kind of monopoly regime for most of the services they offered.

The CEPT expanded quickly to include most of Europe, including mini- and micro-states, from Iceland to Cyprus. The Central and Eastern European countries formed their own Soviet-controlled organisation, but in recent years, many of them were finally able to join the CEPT.

Now, the picture has changed completely. New technologies have been widely adopted, digital has replaced analogue, optical-fibre systems offer enormous transmission capacities at relatively low cost, etc., and a host of new services has been introduced, some of them offered by the traditional telecommunications operators, other by new 'players' in the field.

A new approach to telecommunications policies was badly needed, in order to respond to the complex and potentially conflicting pressures arising from changes in the world economy.

## EC Developments

Already in the 1970s, the European Community (EC) had been pushing for more standardisation and harmonisation in order to create a truly open market for telecommunications services and equipment in Europe. The CEPT responded by establishing a considerable number of committees and groups which failed in some cases (for example, we still have several incompatible standards for videotex), but also achieved quite a lot—for example, the European pulse-code modulation standard (64 kbit/s, 2 Mbit/s).

A major milestone was the publication of the EC's Green Paper on

This article is based on a paper presented at the 31st European Telecommunications Congress, held in Granada, Spain, 27 September–2 October 1992.

* Now Telecommunications Standardisation Sector and Radiocommunications Sector, respectively.

Telecommunications in 1987. The Green Paper called for (among other things) more competition in services and in terminal equipment in particular, for cost-oriented tariffs (still a hot debate), for the complete separation of regulatory functions and operational activities (players cannot be umpire at the same time) and for mutual recognition of type approval, in order to stimulate the open market for terminal equipment. It also introduced the concept of Open Network Provision and proposed the creation of a European institute for telecommunication standards.

There have been a considerable number of new draft proposals, regulations, etc. ever since, but an analysis of all those ideas would need at least a separate article. It should be noted however, that although in principle the EC has no jurisdiction outside the EC area, in practice its influence goes far beyond the EC borders, and this phenomenon will be institutionalised in the near future in the concept of the European Economic Area.

## European Telecommunications Standards Institute (ETSI)

As far as standards-making was concerned, the CEPT responded swiftly, and as early as March 1988, with the help of industry and users' organisations, the European Telecommunications Standards Institute (ETSI) was created and established at Sophia-Antipolis near Nice. ETSI is an association, and all of its members—administrations, industry, operators, users, and many other interest groups—have equal rights, apart from the fact that the voting power is related to the telecommunication turnover of each member.

ETSI is now a very productive organisation; about 60 Technical (sub-) Committees assisted by approximately 25 Project Teams, with more than 2000 experts participating in the work, produce more than 200 European Telecommunication Standards (ETSs) a year. Unfortunately, ETSI is burdened with complicated EC rules in the area of procedures which are supposed to be a balance between efficiency and democratic decision-making.

The equal status of members from different groups is a great asset of ETSI. In the world of telecommunications, this presented a step forward compared to the ITU for instance, where decisions are for administrations/regulators only, although in standards-making most of the work is done by operators and industry. The ITU Additional Plenipot in December 1992 laid the basis for a more open structure, but results will take time.

## Changes in the European Telecommunications Environment

In the 1980s, profound changes were initiated in Europe and are still going on in the 1990s. Increasing competition made it necessary to give telecommunications operators more flexibility and that included a separation from the state and the creation of private companies. Pioneer in this area was certainly Telefónica de España, founded in 1926 as a private company. In the new period, BT became a private company already in 1984. Others such as Telecom Eireann and Royal PTT Nederland NV followed suit. In some cases, the government started to sell part of its shares to the public, but in most European countries the telecommunications operators are still state owned. France and Germany were later in establishing a telecommunications operator which could work more independently from the government, but in those countries, the personnel kept their status as civil servants (statut de fonctionnaire, Beamtenstatus), certainly because of the pressures from the unions who were afraid that some privileges would disappear.

But all the changes pointed in the same direction; that is, more flexibility and more distance from the state, and that includes the complete separation of the regulatory functions from the operational activities.

## Changing Role of CEPT

What has happened to the CEPT in the meantime? Frankly, the operators and the regulators became increasingly unhappy with each other. A large part of CEPT/Telecommunications—that is, those groups charged with making standards—moved to ETSI in 1988. For the remaining groups, it was decided in 1990 to separate operators' and regulators' committees and to give them more authority than before; this left the CEPT/Telecommunications plenary meetings virtually powerless.

Furthermore, it became common practice to agree on more practice-oriented matters in separate Memoranda of Understanding; for example, for the implementation of the integrated services digital network (ISDN) and for the METRAN project.

On the other hand, the CEPT had a number of applications from new members after 1989, because of the collapse of the communist regimes. In these countries, telecommunications were traditionally organised in administrations, but the changes in that area are occurring very fast and already several Central and Eastern European countries have separate operating companies, often more than one.

Anyway, the CEPT decided in 1991 that it would become a regulators-only organisation in 1992, and that meant the end of the CEPT for the operators. It should be mentioned here that this decision also applied to the postal operators who are now in the process of creating their own body.

## New Cooperative Initiatives

Already in 1989, telecommunications operators held short ad hoc meetings form time to time, for instance in order to establish common views to be defended in the next meeting of the CEPT.

*Operators are aware that to meet the new challenges facing them, they need to develop a new cooperative framework for improving the provision of services for the benefit of the customers.*

Consequently, the public network operators have come to realise that, as their relations with each other are becoming increasingly competitive, they need to develop more dynamic means for cooperation in certain areas, and for specific purposes.

Having this in mind, in 1991, EURESCOM, the European Institute for Research and Strategic Studies in Telecommunications, was established as a limited liability company having its seat in Heidelberg, Germany. Among other objectives, operators are trying, through EURESCOM, to develop harmonised strategies for the planning and the provision of future European public telecommunications network infrastructure and services; to stimulate and coordinate common participation in pre-competitive and pre-normative research projects; and to contribute to European and worldwide standardisation.

The result of EURESCOM's activities will be used by its members to complement their own research and strategic planning.

EURESCOM was the first initiative taken by the public network operators to achieve closer cooperation for the purpose of enabling them to develop an appropriate response in the new environment.

ETIS, the European Telecommunications Informatics Services, is a foundation also set up in 1991 by telecommunications operators who basically wished to improve pan-European services for customers by fostering cooperation between the informatics departments of the European public telecommunications network operators for the benefit of the customers.

EPOS, or European PTOs' Open Learning Service, is a project which began in 1989 to deal with a first pre-competitive stage of a future educational telematic advanced service, which the telecommunications operators would offer to internal and external users, supported by their own networks. In view of the satisfactory results obtained, the participating operators signed a Memorandum of Understanding to explore new opportunities for collaboration in this area, by means of an international company based in Zurich.

## Need for a New Cooperative Framework

In addition, network operators have found the need to influence and respond urgently to legislation being formulated by the Commission of the European Communities, in areas that affect the broader dimension of the operators' role as providers of the basic telecommunications networks and services. Those decisions will have profound repercussions on all aspects of the telecommunications sector, and new regulations will have to be devised to ensure that the efforts to make European telecommunications more competitive on the world stage do not invalidate the equally important plans for harmonisation in certain areas, where cooperation will be required in order to implement them.

The process of making European telecommunications competitive in the international arena should be carried out in an equitable manner. The fact must not be overlooked that responsibility for the basic voice telephony services and maintenance of the network so far rests with the public network operators.

The huge investments already made in existing and future telecommunications infrastructures must not be jeopardised, and the thrust towards new technological advance should truly represent a breakthrough in understanding, not a breakdown of one of the basic instruments for the progress of our societies.

Operators are therefore aware that to meet the new challenges facing them, they need to develop a new cooperative framework for improving the provision of services for the benefit of the customers. It must be a cooperative framework that would not increase the resources for cooperation between operators, but would facilitate their more effective allocation.

And perhaps more importantly, operators are involved in different projects which represent important commitments in investments and manpower, and the success or failure of those projects will greatly influence the future of the operators themselves. Therefore, in order to develop and utilise those projects effectively, operators must pay particular attention to avoiding duplication of their efforts.

## European Public Telecommunications Network Operators' Association (ETNO)

Consequently, what European network operators urgently needed, and indeed have been compelled to seek, as a result of the recommendations spelled out in the European Commission's Green Paper, and of the restructuring of the CEPT, was an appropriate forum which could serve as the umbrella organisation for coordination of the pan-European developments undertaken by the European public telecommunications network operators.

Such a body, organised along the lines of a Chamber of Commerce, and specifically suited to addressing the challenges facing operators, would enable operators to discuss, coordinate and represent their views to other organisations and political bodies, especially the Commission of the European Communities, in much the same way as other players in the sector (regulators, industry, users and services providers) have grouped together to protect their own common interests as well. Of course, the EC regulations in the area of competition had to be respected.

A group of operators did recognise the need for action, and early in 1991 Telefónica de España was asked to coordinate a study on how to set up such an organisation, which was envisaged as taking the form of an Association. In Telefónica, this new role was seen as an opportunity to

*the primary objective of the Association is to implement the representation of common views on those issues of interest to all members*

apply its experience, gained as a private telecommunications operating company, to the task of welding the operators' entrepreneurial independence to the imperative need for cooperation.

On 28 February 1991, in Brussels, representatives from 26 operators signed a Memorandum of Understanding for the purposes of elaborating the Statutes, the General Internal Regulations, and the structure of an association which would allow, in the best possible way, two basic aims to be achieved:

- to adopt common positions on the issues which affect its members, and represent those common views to other organisations, especially the Commission of the European Communities; and

- to cooperate in the process of harmonisation of the pan-European networks.

On 12 May 1992, in Madrid, all of the 26 operators signed the Statutes, which set forth the object of the Association and provide for ETNO to be established as a Belgian International Association.

The Statutes also stipulate the qualifications for membership, the method of financing, the relations with the European Community and the internal structure, which consists of a General Assembly, a Steering Committee, an Administrative Board, and a Permanent Secretariat; Working Groups are established on an ad hoc basis.

## ETNO Activities

The outputs that ETNO may generate in the development of its functions, which will be determined by three possible types of decisions, are as follows:

- *Common Positions*, reached by consensus of the Association's members, and relating directly to the first objective of ETNO;

- *Guidelines*, for the internal guidance of ETNO members, relating to the second objective of the Association, which is to cooperate for the harmonisation of pan-European networks;

- *Resolutions*, for the internal management of the Association and binding upon its members; and

- *Reports*, on subjects of common interest to the members, which the Association may on occasion decide to publish.

At present, a number of ETNO ad hoc groups have been set up to study the areas of 'ITU Matters', 'Satellite Communications', the initiatives of the CEC regarding 'Data Protection', 'EC Industrial Policy', 'Numbering Issues', 'ONP', 'Review of the Services Directive', 'Telecommunications Tariffs', and furthermore 'Frequency Management', 'EC Framework Programmes', and 'Strategic Network Planning'*.

Evidently, all of these mentioned activities are related to the primary objective of the Association which is to implement the representation of common views on those issues of interest to all members.

## Coordination of Relationships with other Bodies

With a more direct bearing on the objective of cooperation for the harmonisation of European telecommunications networks, the ETNO Committee on CEPT Matters (ECCM) was set up with a mandate to review, from the perspective of strategic cooperation between operators, the work that up to now had been carried out by operators' groups within the CEPT.

Of significant interest are the following points among the main proposals contained in the ECCM report:

- identification of the operators' activities of permanent interest to ETNO;

- the recommendation that ETNO oversees the operators' groups relating to Numbering Plans, Frequency Management and the EC Framework Programme;

- the recommendation to set up a Working Group on ITU relations; and

- the recommendation that relations be established between ETNO and a large number of organisations in the area of telecommunications.

Furthermore, a procedure was elaborated for coordinating the different operators' positions where they are represented, such as EURESCOM, ETIS, ETSI and European Memoranda of Understanding, as well as to world organisations such as the ITU.

Coordination will also be carried out with respect to those organisations in which ETNO's members have a special interest, such as EFTA, GATT, users' organisations, suppliers' organisations, and regulators' organisations, as well as in the field of public relations.

## Conclusion

ETNO will be an effective means by which all of the members will be able to approach each other for the purposes of coordination and cooperation in order to address the different and complex problems that affect them, while at the same time respecting each other's commercial autonomy.

Such an approach must therefore be in terms of achieving long-term, pan-European strategic goals, arising from an awareness on the part of the European network operators of the larger context of their role in the European telecommunications sector. ETNO will try to serve that purpose.

---

* For further information, please refer to ETNO Secretariat, Bd Bischoffsheim 33, B 1000C Brussels; Tel: +32 2 219 32 42; Fax: +32 2 219 64 12.

## *Biographies*

**Manuel Avendaño**
Director of International Relations
Telefónica de España

Manuel Avendaño is currently Director of Telefónica's International Relations. Prior to this, he held the posts of Telefónica's Permanent Representative in Brussels, of Director of Corporate Planning and of Director of the Chairman's Office of Telefónica. He obtained the degree of Telecommunications Engineer from the Polytechnic University, Madrid, where he was also a Professorial Lecturer. He is also a graduate in Managerial Functions and Business Management. He was the Chairman of the ETNO Launching Group and is currently a member of the ETNO Steering Committee.

**Peter J. C. Hamelberg**
Director of Standards and International Affairs
PTT Telecom BV, The Netherlands

Peter Hamelberg is currently Director of Standards and International Affairs for PTT Telecom BV of the Netherlands. Prior to this, he has held leading posts in transmission data communications and business communications in the Dutch PTT. In 1992, he was elected Chairman of the ETSI Technical Assembly. He obtained an M.Sc. degree in Electronics from the Technical University of Delft in 1964. He was a member of the ETNO Launching Group and a member of the ETNO Steering Committee until 1 January 1993. He was an active member of the Federation of Telecommunications Engineers of the European Community (FITCE) for many years and was President of FITCE for the period 1988–1990.

*Alan Quayle and Andy Humphreys*

# A Method for Compatible Coding of HDTV and TV

*This article gives an overview of an algorithm to compress TV and high-definition TV (HDTV) resolution video compatibly, and describes the results of a study comparing band-split compatible transmission with simulcast. The algorithm was implemented by BT as part of a collaborative RACE I project.*

## Introduction

One of the most important issues facing the broadcast industry at present is the difficulty in upgrading video services. To introduce an upgraded incompatible service can be expensive for the consumer and the industry. It can also significantly inhibit market growth. One solution to this problem is to use compatible techniques, whereby both the existing and new receivers can be used for the same transmission but receive a different quality of service. Future service upgrades can then be introduced by evolution rather than revolution. An example of this method was the upgrade from black-and-white TV to colour TV. Another method of introducing an upgraded service would be to transmit it in a completely different channel; that is, two services running in parallel, which is termed *simulcast*. Simulcast is a contraction of *simul*taneous broad*cast*. An example of such a strategy was the simulcast of 405 line transmission in the very high frequency (VHF) spectrum and 625 line transmission in the ultra high frequency (UHF) spectrum.

This article considers compatible and simulcast compression coding methods for digital TV and HDTV. Uncompressed HDTV transmission has a data rate of approximately 1·2 Gbit/s. Compression coding allows the data rate of HDTV to be reduced to about 20 to 40 Mbit/s for a quality suitable for the viewer in the home.

BT is a member of the HIVITS-B (HIgh quality VIdeotelephony, Television and high definition television Systems) RACE I (Research and technology development in Advanced Communication technologies in Europe) project in which algorithmic research, codec architecture and VLSI design for a range of video codecs were undertaken. The work described in this paper was carried out in a working party (wpb2) investigating compatible coding of HDTV and TV resolution video. Compatible coding refers to two or more resolutions of a video service, transmitted in the same channel, exploiting the common information between them to reduce the total bit rate.

BT developed a software simulation of the HIVITS wpb2 reference model [1] which is a band-split compatible video coding algorithm. Band-splitting is a technique that separates the spatial frequency components of the input HDTV into a HD (high definition) coding algorithm and a TV coding algorithm. This model was used to study the network issues of band-split-based compatible coding. There are several methods to compatibly code multiple video resolutions though only band-split compatible coding is described in this article. Other work into compatibility at BT includes the COSMIC[2] proposal to the International Standards Organisation in 1991. That approach splits an image into two or more resolutions in the pel (picture element) domain rather than the spatial frequency domain.

## Overview of the Compatible Coding Algorithm

There are three dimensions of redundancy in video coding, two spatial dimensions and a temporal dimension. Spatial redundancy arises from the fact that pels (picture elements) are usually highly correlated to their neighbours. Temporal redundancy occurs because successive frames in a

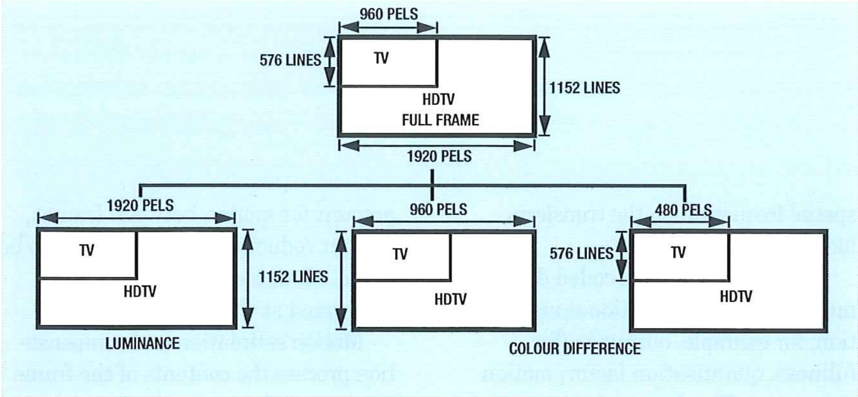



*Figure 1—Typical video sampling dimensions*

video sequence are usually very similar. The first two dimensions of redundancy are used in intra-frame coding, whilst all three dimensions are used for inter-frame coding.

Each video frame consists of three signals, namely *luminance* and two *colour difference* components. The colour differences are sub-sampled horizontally to half the resolution of the luminance, without apparent loss in resolution, since the eye has less acuity to colour. Therefore a colour difference pel is twice as wide as a luminance pel. In this study the interlaced fields of a frame are treated as one progressive frame. Figure 1 shows the typical video resolutions of the HDTV and TV components. Frames are divided into macro-blocks and image blocks as shown in Figure 2, that are used in the description of the coding algorithms. Macro-blocks have both a luminance and a colour difference block as shown in Figure 2.

Three coding algorithms are described. The first algorithm, intra-frame coding, simply processes a frame to reduce redundancy within a frame. The second algorithm, inter-frame coding, is the intra-frame algorithm with feedback. Feedback allows frames to be compared and redundancy between frames can then be reduced, as well as reducing redundancy within a frame. The final algorithm, compatible coding, uses two inter-frame algorithms in parallel to code TV resolution and HDTV resolution video.

## The intra-frame coding algorithm

Figure 3 shows a block diagram of the principal functional units of the intra-frame coding algorithm. The input frame is split into 8 by 8 pel image blocks and each image block is transformed into the frequency domain using the discrete cosine transform (DCT)[3] to form an 8 by 8 DCT transform block.

Figure 4(*a*) shows a luminance image block in the pel domain represented as pulse-coded modulation (PCM) levels. Figure 4(*b*) shows the same image block transformed into the spatial frequency domain.

The top left-hand coefficient (DC coefficient) of the transformed image

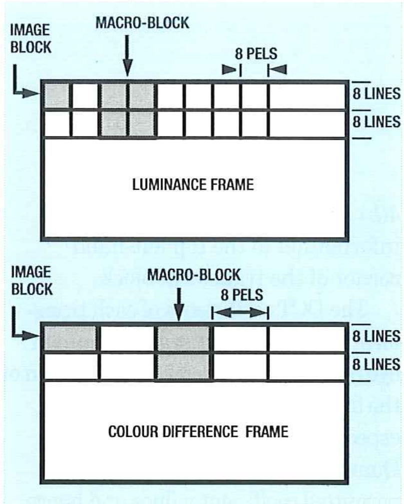



*Figure 2—Frame block dimensions*

block (transform block) represents a scaled average pel value for the image block. All other coefficients represent the amplitude of a spatial frequency. With increasing distance from the dc coefficient, DCT coefficients represent higher spatial frequencies. For example, the bottom right-hand coefficient represents the highest horizontal and vertical spatial frequency component. In natural scenes there are few high-frequency components. As can be seen in Figure

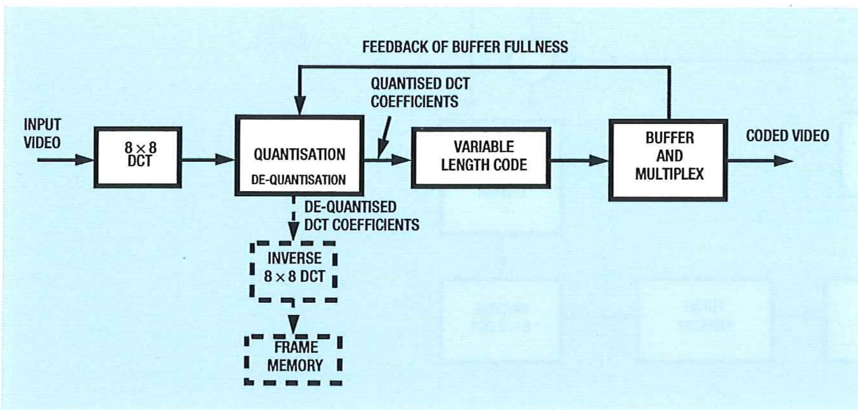
*Figure 4(a)—Pel domain image block*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21 | 21 | 21 | 22 | 23 | 25 | 27 | 28 |
| 23 | 23 | 23 | 23 | 25 | 26 | 28 | 28 |
| 24 | 25 | 26 | 27 | 28 | 30 | 32 | 33 |
| 26 | 26 | 27 | 30 | 34 | 37 | 39 | 40 |
| 28 | 28 | 30 | 33 | 38 | 44 | 44 | 46 |
| 27 | 29 | 31 | 34 | 39 | 43 | 47 | 49 |
| 27 | 27 | 28 | 33 | 39 | 44 | 47 | 48 |
| 23 | 24 | 27 | 31 | 37 | 42 | 47 | 49 |

*Figure 4(b)—Spatial frequency domain image block*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 254 | –45 | 5 | 2 | 0 | 0 | 0 | 0 |
| –38 | 21 | 0 | –1 | 0 | 0 | 0 | 0 |
| –15 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 5 | –1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | –3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | –1 | 0 | –2 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Figure 3—Intra-frame coding loop*



4($b$) the DCT has concentrated the information to the top left-hand corner of the transform block.

The DCT coefficients of each transform block are quantised. The human eye does not easily detect quantisation of the amplitudes of spatial frequencies, especially higher spatial frequencies. Quantisation reduces the number of permitted coefficient values and hence the number of bits required to represent them. The number of quantisation levels for each coefficient is modified for each row of macro-blocks depending on the output buffer fullness and a weighting matrix specified in Reference1. As the output buffer fills, the number of quantisation levels can be reduced so less bits are required to represent each coefficient, hence avoiding over-flow of the output buffer. The weighting matrix uses the eye's reduced awareness to coarse quantisation at high frequencies. Thus fewer bits are required to code the higher spatial frequencies without noticeably impairing image quality. Once the DCT coefficients are quantised, they are then variable-length coded. Variable-length coding[4] removes redundancy in the coefficient data; for example, the runs of zero value DCT coefficients that exist at the higher spatial frequencies in the transform block.

The variable-length coded data is multiplexed with additional information; for example, output buffer fullness, quantisation factor, motion vectors etc. The data is then temporarily stored in a buffer to match the output data rate to a fixed bit rate network. The dequantised and inverse transformed frame is written into a frame memory. The frame memory contains the same pel values the receiver will decode, provided there are no channel errors. These values are used in inter-frame coding.

### The inter-frame coding algorithm

Figure 5 shows an outline block diagram of the single loop inter-frame coding algorithm. This algorithm is essentially the intra-frame coding algorithm with feedback, so that redundancy between frames can be removed as well as within a frame. Feedback allows the contents of the frame memory and the input image to be compared and the difference coded. Only where there is movement between the frames will there be information to code. Motion estimation and compensation attempt to account for motion between frames, further reducing the information to be coded. Motion estimation is only performed at the encoder.

Motion estimation and compensation process the contents of the frame memory, to form a prediction of the present input image. Without motion compensation only the static areas between frames will give a reduction in bit rate. Motion estimation compares the present and previous input frames to determine how elements of the images have moved between the input frames, the movement of the elements being described by motion vectors. Motion compensation moves the elements of the frame memory to form a prediction of the present input image. To achieve the smallest prediction error every pel could be motion estimated and compensated. The number of motion vectors required would outweigh the reduction in prediction error. A motion vector per macro-block gives a good compromise.

Figures 6($a$)–($c$) depict graphically the motion estimation and compensation processes. Macro-blocks of the present input luminance frame are scanned around search areas in the previous input luminance frame to find a best fit, as shown in Figure 6($a$). The shift of the

*Figure 5—Inter-frame coding loop*

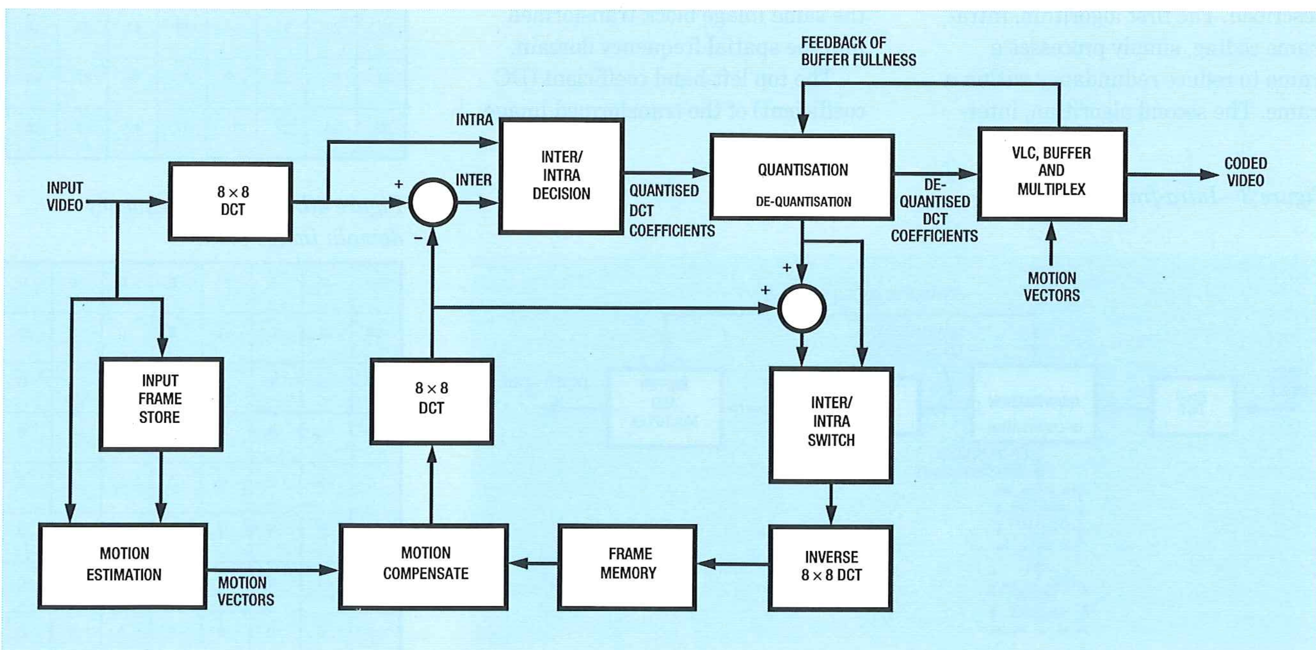
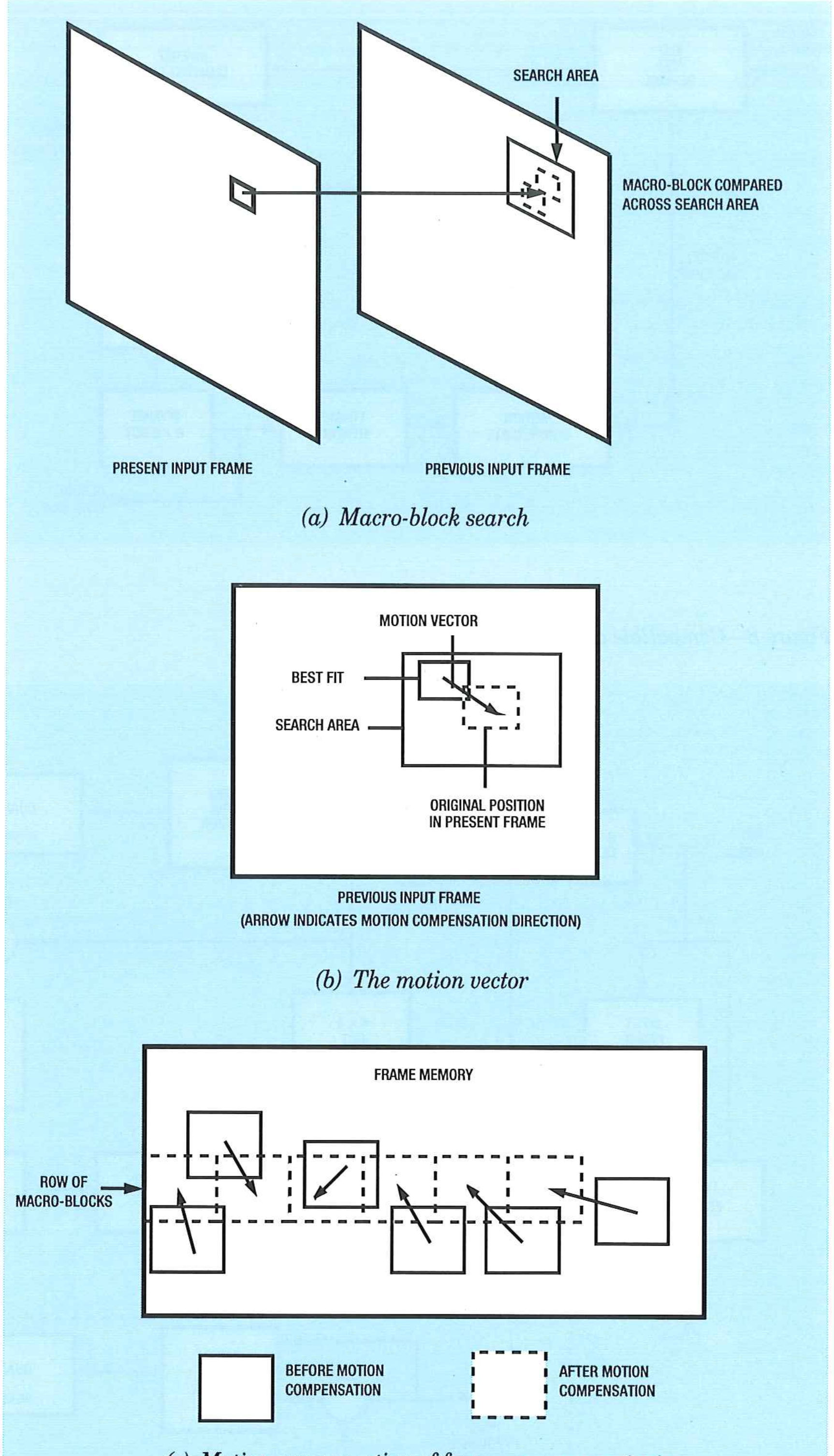


Figure 6—Motion estimation and compensation




*(a) Macro-block search*

*(b) The motion vector*

*(c) Motion compensation of frame memory contents*

macro-block from the best fit position to its original position is termed a *motion vector,* as shown in Figure 6(*b*).

The motion vectors are then used to shift macro-blocks for both the luminance and colour difference components of the frame memory from the 'best fit' position to the original position as shown in Figure 6(*c*). Motion vectors are multiplexed with the coded video data, so the receiver will also be able to create the same prediction of the present input frame.

Once the contents of the frame memory are motion compensated, it is split into image blocks and transformed into the spatial frequency domain. The input image frame is also transformed into the spatial frequency domain, this being termed an *intra-frame.* An inter-frame is the difference between the motion compensated frame memory contents and the present input frame in the transform domain. The inter- and intra-frame transform blocks are compared to make a decision on which mode will take less bits to transmit. The resulting mode information is multiplexed with the coded video data.

Rows of macro-blocks are now quantised, variable-length coded (VLC), multiplexed and buffered as in the intra-frame coding algorithm. The dequantised and inverse transformed image is written to the frame memory, but as can be seen in Figure 5 there is an added complication in forming the decoded frame because of the inter-frame macro-blocks. Inter-frame macro-blocks represent the difference in the frequency domain between the input frame and the present frame memory. Hence the difference must be added to the present frame memory before it is transformed back to the pel domain, ready to be motion compensated. Mathematical rounding errors and channel errors may result in the contents of the encoder's and decoder's frame memory not being exactly the same. Every thirteenth frame is completely intra-coded to reset any accumulated differences.

Figure 7 shows an outline block diagram of the inter-frame decoding algorithm. Comparing Figure 7 to Figure 5 it can be appreciated that the decoder is formed from part of the encoder. The input coded video is variable-length decoded (VLD) and demultiplexed. The motion vector data and the inter/intra decisions, which were multiplexed in the coded data, are then used in the decoding loop for motion compensation and inter/intra macro-block switching respectively. The inverse-quantised DCT coefficients are then added to the contents of the frame memory in inter-frame mode or written directly into the contents of the frame memory in intra-frame mode. The contents of the frame memory are inverse transformed back to the pel domain to form the decoded frame which is displayed to the viewer. The frame memory contents are motion compensated and transformed back into the spatial frequency domain so inter-frame macro-blocks of the next received frame can be added to the frame memory.

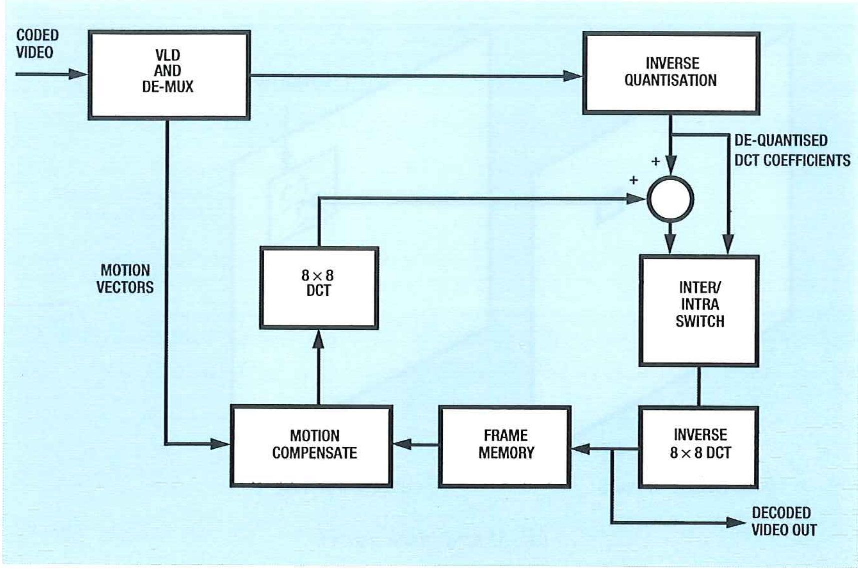



*Figure 7—Inter-frame decoding loop*

## The compatible coding algorithm

The compatible algorithm is essentially two inter-coding loops in parallel, but with the TV loop nested inside the HDTV loop. Hence a TV decoder can use part of a compatible HDTV transmission to recreate pictures which appear to have come from a TV encoder.

Figure 8 shows a block diagram of the principal functional units of the band-split compatible coding algo-

*Figure 8—Compatible coding algorithm*

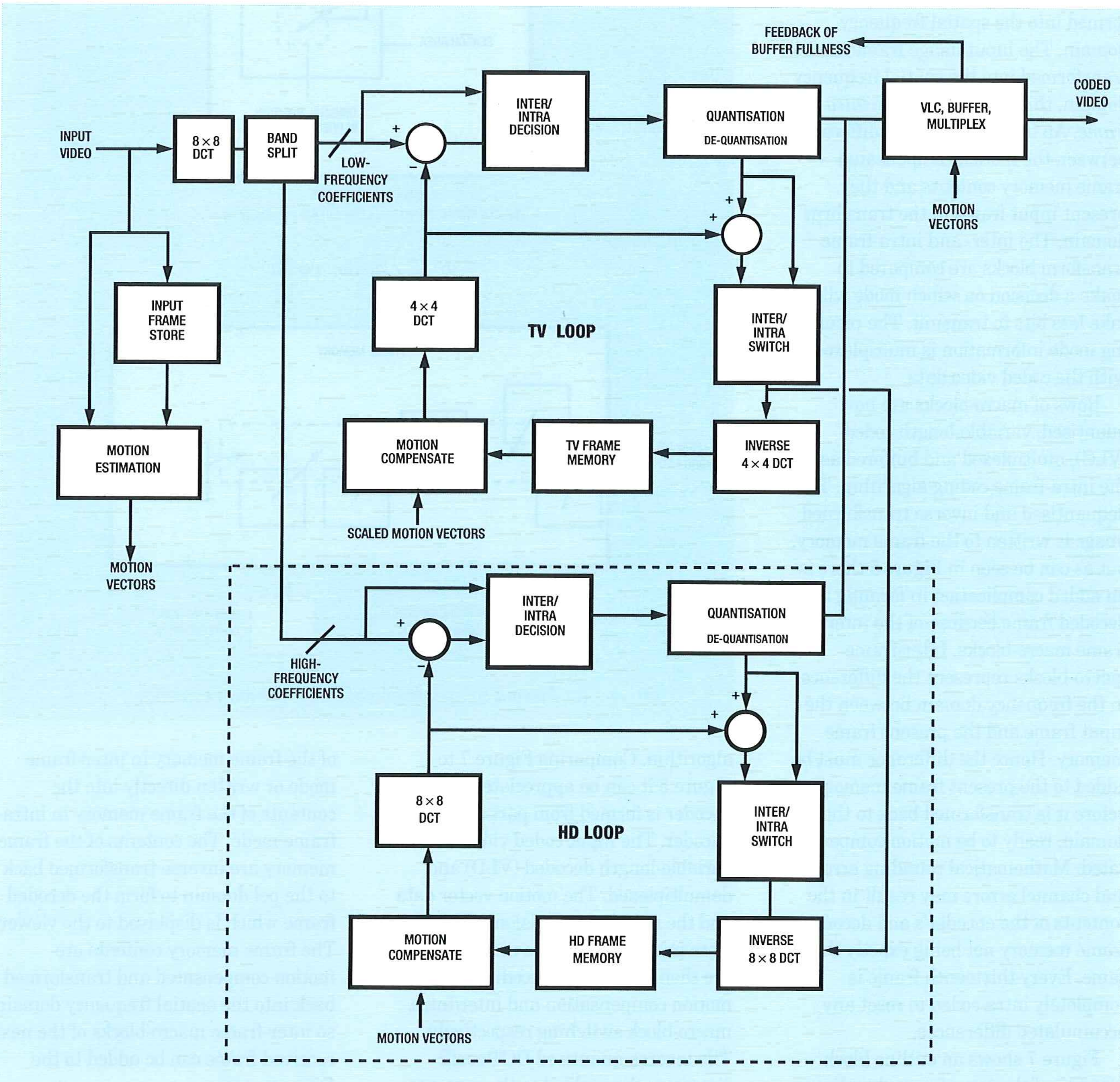
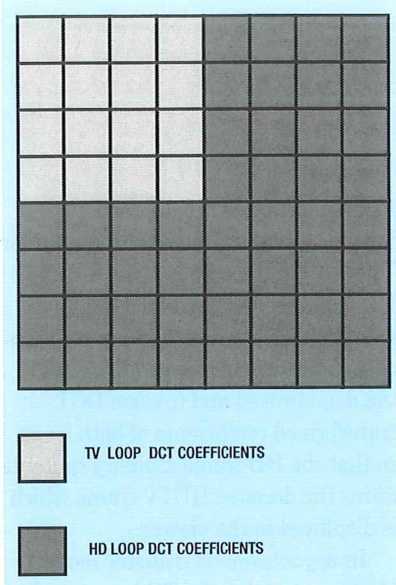


*Figure 9—Split of HDTV DCT coefficients between TV and HD loops*



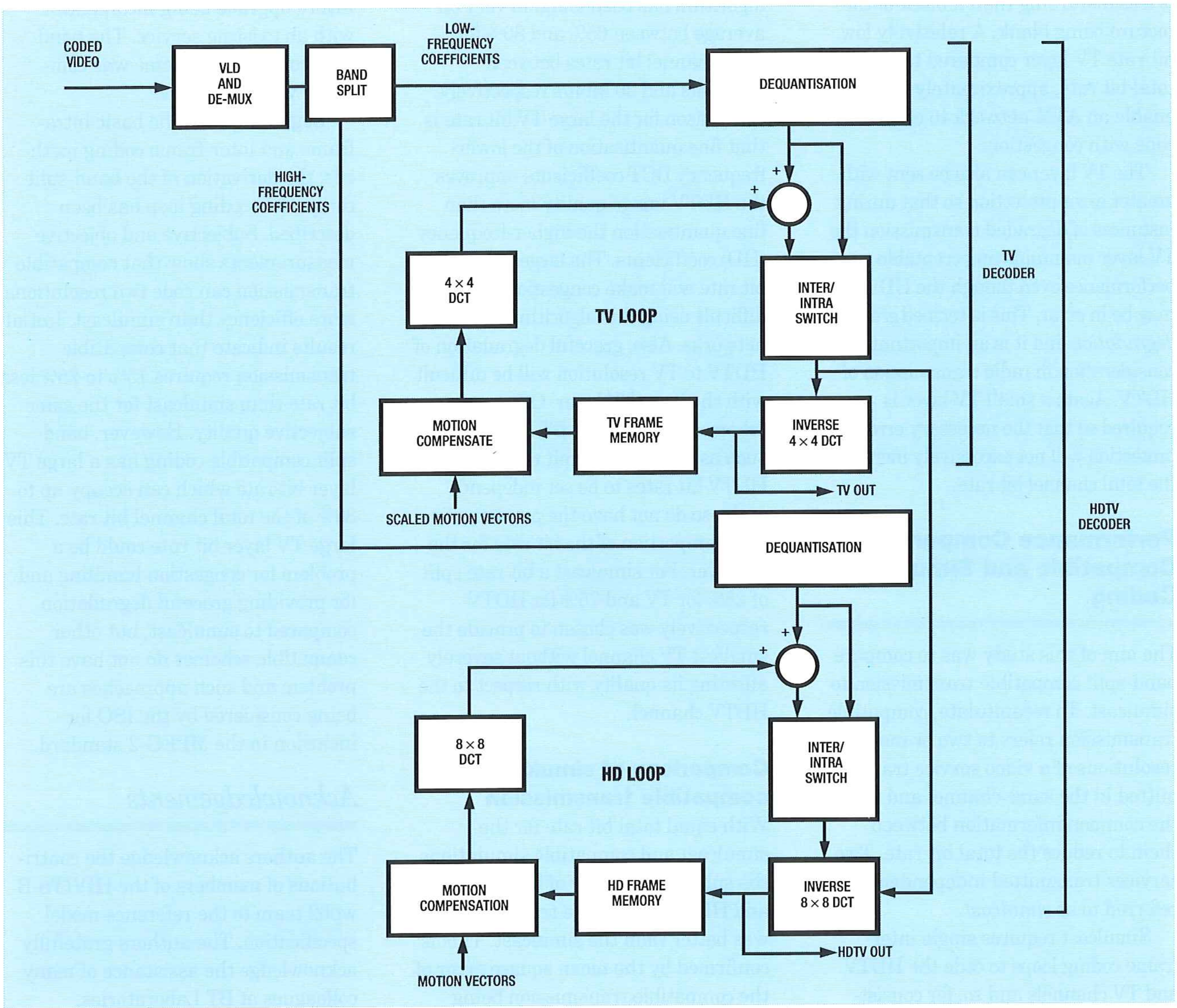

rithm. It consists of two inter-frame coding loops. Because a TV resolution receiver needs to keep in track with the encoder during inter-frame transmission without having the hardware complexity of a HDTV decoder, the TV encoding loop is provided. A HDTV receiver needs extra information to form the HDTV image and this is obtained in the HD encoding loop.

Figure 9 shows how the DCT coefficients of a transformed image block are band-split between the HD and TV loops. The HD loop frame memory contents are formed from the dequantised and inverse transformed coefficients of both the TV loop and HD loop, so that the HD frame memory contents represent the decoded HDTV image which is then motion compensated to predict the next one.

The motion vectors are generated in the HD loop and are scaled down for the TV loop. The HD and TV loop inter- and intra-frame macro-blocks are compared to make a decision on which mode will take less bits to transmit and this decision is applied to both loops. The outputs of both quantisers are recombined to form the full HDTV row of macro-blocks which is then VLC coded, multiplexed and buffered for a constant output bit rate.

Figure 10 shows an outline block diagram of the compatible decoding algorithm. It consists of two inter-frame decoding loops. The TV frame

*Figure 10—Compatible decoding loop*



memory contains the decoded TV image. Only the TV loop is required for TV resolution reception. The TV and HD loops are required for HDTV reception. The frame memory contents of the HD loop are formed from both the dequantised and inverse DCT transformed coefficients of both loops, so that the HD frame memory contents forms the decoded HDTV frame which is displayed to the viewer.

In asynchronous transfer mode (ATM) networks, the TV layer can be sent with a higher priority than the HD information so that when the network is congested the HD packets can be discarded and just the TV layer can be carried. This results in blocks of the HDTV picture being displayed at a lower resolution, which is less disturbing than a block of the picture being blank. A relatively low bit rate TV layer compared to the total bit rate, approximately 25%, will enable an ATM network to efficiently cope with congestion.

The TV layer can also be sent with greater error protection so that during instances of degraded transmission the TV layer maintains an acceptable performance even though the HD layer may be in error. This is termed *graceful degradation* and it is an important consideration in radio transmission of HDTV. Again a small TV layer is required so that the necessary error protection will not excessively increase the total channel bit rate.

## Performance Comparison of Compatible and Simulcast Coding

The aim of this study was to compare band-split compatible transmission to simulcast. To recapitulate, compatible transmission refers to two or more resolutions of a video service transmitted in the same channel and using the common information between them to reduce the total bit rate. Two services transmitted independently is referred to as *simulcast*.

Simulcast requires single inter-frame coding loops to code the HDTV and TV channels and so, for consistency of results, the TV loop of the compatible coding algorithm was used for simulcast TV coding and a scaled TV loop for simulcast HDTV coding. The compatible coding algorithm is not sophisticated as its purpose was to investigate the network issues of compatible coding rather than achieving high compression, but the results will be generally applicable to band-split compatible coding. The results presented here are the average from simulation of five sequences each of 25 frames and thus the results can only be treated as an indication of the algorithm's performance.

### TV and HD loop bit rates

The proportion of bit rate devoted to the TV layer for the compatible algorithm has been found to vary on average between 65% and 80% for total channel bit rates between 80 Mbit/s and 20 Mbit/s respectively. The reason for the large TV bit rate is that fine quantisation of the lower-frequency DCT coefficients improves the HDTV image quality more than fine quantisation the higher-frequency (HD) coefficients. The large TV layer bit rate will make congestion control difficult using this algorithm in ATM networks. Also, graceful degradation of HDTV to TV resolution will be difficult with the large TV layer. Other schemes developed at BT Laboratories such as COSMIC permit the TV and HDTV bit rates to be set independently, so do not have the problem of a large proportion of the bit rate for the TV layer. For simulcast a bit rate split of 25% for TV and 75% for HDTV respectively was chosen to provide the smallest TV channel without severely affecting its quality with respect to the HDTV channel.

### Comparison of simulcast and compatible transmission

With equal total bit rate for the simulcast and compatible simulations, the subjective quality of both the TV and HDTV compatible transmission was better than the simulcast. This is confirmed by the mean square error of the compatible transmission being approximately 1 to 2 dB better than the simulcast for both HDTV and TV. This shows that compatible transmission can code two resolutions more efficiency that simulcast.

The simulcast scheme had the total channel bit rate increased until the subjective quality of the TV and HDTV channels were comparable to those of the compatible scheme. Initial results indicate that the increase in total channel bit rate was about 10% to 20% depending on the image sequence.

## Conclusion

One of the problems facing the broadcast industry is the difficulty in upgrading video services. Compatible coding provides a method to avoid a future upgrade being incompatible with an existing service. The band-split compatible scheme was compared with simulcast.

Beginning with the basic intra-frame and inter-frame coding methods, the derivation of the band-split compatible coding loop has been described. Subjective and objective measurements show that compatible transmission can code two resolutions more efficiency than simulcast. Initial results indicate that compatible transmission requires 15% to 25% less bit rate than simulcast for the same subjective quality. However, band-split compatible coding has a large TV layer bit rate which can occupy up to 80% of the total channel bit rate. This large TV layer bit rate could be a problem for congestion handling and for providing graceful degradation compared to simulcast, but other compatible schemes do not have this problem and such approaches are being considered by the ISO for inclusion in the MPEG-2 standard.

## *Acknowledgements*

The authors acknowledge the contributions of members of the HIVITS-B wpb2 team to the reference model specification. The authors gratefully acknowledge the assistance of many colleagues at BT Laboratories.

## *References*


1 Reference Specification of the HIVITS Compatible Coding Scheme. Internal Document RACE 1018 (18/THO/LER/DN/C/123/a1/ WPB2)

2 MORRISON G., and PARKE I. COSMIC: A Compatible Scheme for Moving Image Coding. *Signal Processing: Image Communications* **5**(1–2), Feb. 1993.

3 CLARKE, R.J. (1985) Transform Coding of Images, Academic Press, London.

4 DELOGNE P. Universal Variable Length Coding for an Integrated Approach to Image Coding. *Ann. Telecommun.* **46**(7–8), 1991.


## *Further Reading*


Image Processing, Edited by Don Pearson, The Essex Series in Telecommunication and Information Systems. ISBN 0-07-707323-1.

TOURTIER, P. J. *et al.* Motion compensated subband coding schemes for compatible high definition TV coding. *Image Processing* **4**(4–5), 1992, pp. 325–344.

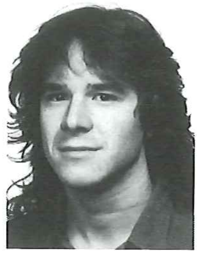
BOSVELD, F. *et al.* Hierarchical coding of HDTV. *Image Processing,* **4**(4–5),1992, pp. 195–225.

*Signal Processing: Image Communications.* **5**(1–2), Feb 1993 (This is a special issue on proposals for MPEG-2).


## *Biographies*


**Alan Quayle**
BT Development and Procurement


Alan Quayle joined BT in 1986 as a sponsored student. He graduated from York University in 1990 with an M.Eng. in Electronic System Engineering. During his degree he completed a 6 month project at BT Laboratories studying metal-gated magneto-Hall measurements of 2-D electron gases. In 1990, he joined the devices devision at BT Laboratories to work on test, measurement and design on a range of high-speed integrated circuits and opto-electronic integrated circuits based on InP and GaAs. In 1992, he moved to the broadband and visual networks division to represent BT in the RACE 1 HIVITS applications group. He is also working on future TV/HDTV broadcast networks and video coding aspects of business TV and other services.




**Andy Humphreys**
BT Development and Procurement


Andy Humphreys joined the United Kingdom Atomic Energy Authority in 1985 as a sponsored student. He graduated in 1989 from Robert Gordons Institute of Technology in Aberdeen with a B.Eng. honours degree in Electronic and Information Engineering. On graduating, he joined the Visual Telecommunications division at BT Laboratories to work on image coding and compression algorithms for advanced television services. His project work has covered TV and HDTV compression algorithms and still picture transmission systems. More recently he has moved into the Video Systems development group to work on videophone and videoconferencing products and systems for use with the ISDN.

## BT and MCI Announce Strategic Venture

On 2 June 1993, BT and MCI announced a far-reaching move designed to realise the full potential of the fast-changing world telecommunications markets. They agreed to create a strategic global alliance through a new international joint venture company, which will bring together the complementary technical and marketing skills of two of the world's major telecommunications and information technology businesses.

The two businesses will invest over $1 billion in a new joint venture company to combine their international enhanced voice and data services over an advanced intelligent global network to multi-national companies throughout the world. BT will hold 75% of the equity in the new company, with MCI holding the remaining 25%.

In addition, BT is taking a 20% shareholding in MCI itself at a cost of around $4·3 billion. MCI will acquire most of the business of BT North America. BT will have three directors on the board of MCI and the Chairman of MCI will join BT's board.

Syncordia, set up by BT in 1991 to provide a global outsourcing service for multinational corporations, will be merged with the new company, enabling Syncordia to build on substantial progress it has already made.

This alliance will provide BT, through an investment in MCI, with a significantly enhanced presence in the North American market and will provide MCI, through an investment in the international joint venture, with a greater reach in markets outside North America.

The alliance is expected to bring major benefits to customers of both partners by providing greater spread, innovative services, and the combined strength of two global communications firms. The new joint venture company will provide BT and MCI with state-of-the-art products and applications, based on a common architecture and supported by joint research and development programmes. The new company will provide the global platform for the provision of BT's and MCI's enhanced telecommunications services, including GNS, frame relay, flexible bandwidth, outsourcing and MCI's Vnet service, as well as other products and services which BT and MCI will work together to develop. BT and MCI will jointly manage the new company.

Each of the partners will be responsible for geographical 'distributorships' to market jointly-branded products and services created by the new firm. MCI will take responsibility for the North, South and Central Americas and the Caribbean, while BT will take responsibility for the rest of the world including Europe and the Far East. Basic service will continue to be handled through correspondent relationships, bilateral agreements through which international calls are handled and billed. These arrangements with carriers and government communications authorities around the world will remain in place.

With the new global initiatives of each company combined into the new venture, it is expected to be one of the most dynamic in the world.

## New BT Disaster-Recovery Service to the City and Docklands

CitySure, BT's new recovery service for the City of London and the Docklands, will enable companies' private circuits to be restored more quickly in the event of a major disaster.

Customers affected by a disaster will, under CitySure, have their analogue and digital private circuits recovered within an hour of the incident being reported between 07.30 to 18.00, Monday to Friday. At any other time, BT will ensure that the service is restored within four hours.

BT will rapidly switch all contracted analogue and digital private circuits located at a customers' protected building to a predefined stand-by site. The stand-by site may be owned by the customer, or may be provided by a third party agent with several customers sharing it.

CitySure is part of a multi-million pound investment programme undertaken by BT to improve the city's telecommunications infrastructure and to ensure that London remains among the world's leading financial centres. Although the service is aimed primarily at the financial community, the added network resilience and security should appeal to all customers within the catchment area.

Both the protected and stand-by sites must be served by the London local fibre network, which covers most of the designated area, but the distant ends may go to any UK or international private circuit destination.

Switching will take place within BT premises under manual control to ensure strict security of voice and data communications at 2 Mbit/s. To facilitate this high level of bandwidth, the customer's nominated circuits will be grouped into 2 Mbit/s CitySure bearers between the protected premises and the BT switching node. These will then be mirrored from the BT switch to the stand-by site.

## BT Launches New Initiative in Electronic Trading

BT has announced the formation of EDI Business Team, an alliance of the UK's leading providers of software, systems and management expertise in electronic trading.

Electronic trading, also known as *electronic data interchange* (EDI), is designed to help customers improve their performance by changing the way they do business within their trading communities of customers, suppliers and other service agencies.

At its most effective when part of a 're-engineeering' of business processes, electronic trading often requires the collaboration and support of partners and suppliers—many of whom may need extra assistance to gain maximum benefits within their own organisations.

EDI Business Team is the hub of BT's task force for the large-scale conversion of the UK to electronic trading. It will give customers a wide choice of products and expertise while setting the highest standards for reliability and service quality. Through EDI Business Team, BT is working with the very best sources of electronic trading expertise—members will be promoting electronic trading in all

sectors of the UK economy including governmental and other service agencies.

The founder members of EDI Business Team are: BT; Burns Open Systems; EDS-Scicon; EDI Software Warehouse; EDISYS; Kewill-Xetal; Meadowhouse Bar-Laser; Multilink EDI; Origin; Perwill Group; Reseautique sa; SAA Consultants; Sema Group; SITPRO; Sterling Software; Telesmart API.

Electronic trading is expected to accelerate rapidly during the next three to five years. By the mid-1990s, those businesses still using paper-based transactions will be increasingly uncompetitive. EDI Business Team will make it easier for customers to reach out and improve the way they and their trading partners work together. This will help UK businesses to win by cutting costs, improving customer service and speeding up deliveries.

## BT's Data Network to Help Improve European Air Safety

Eurocontrol, the Brussels-based air-traffic management agency, is to use BT's Global Network Services (GNS) to help improve air-traffic management in Europe. Under a multi-million pound, five-year contract, BT will provide Eurocontrol with a pan-European digital data network as part of its central flow management unit (CFMU) project, which is being implemented on behalf of 29 European states representing the European Commission for Civil Aviation.

The network will be able to transmit information required to manage the movements of aircraft (flight planning information and the location of aircraft, both in the air and on the ground) throughout Europe, providing a centralised overview of the air-traffic situation which was not previously available.

The Eurocontrol organisation, which currently comprises the Civil Aviation Authorities and/or Ministries of Transport of 14 European countries, has had to cope with ever-increasing numbers of flights in and around Europe. The resulting congestion, both on the runway and in the air, causes delays and increases costs to aircraft operators.

GNS will eventually link around 150 locations throughout Europe, from Reykjavik to the Canary Islands, to the CFMU database located in Brussels, with a back-up system in Paris.

## Major New Facilities for BT's ISDN 2 Service

BT has made further improvements to its ISDN 2 service by introducing a new level of maintenance cover, TotalCare, and a direct dialling-in (DDI) facility.

The sophistication of ISDN applications and their importance to users in key business areas has led to TotalCare, which provides greater flexibility and speed of response. Under ISDN 2 TotalCare, BT aims to respond to a reported fault within four hours, 24 hours-a-day, 365 days-a-year. This compares with a 24 hour response provided under the StandardCare scheme.

The introduction of DDI with ISDN 2 reflects the emerging market for ISDN voice services with smaller PABX/Key Systems. ISDN 2 DDI allows incoming calls to be routed to an extension or to other terminal equipment without being handled by the PABX operator, so enabling customers to optimise their use of digital public network connections for both data and voice applications.

## BT's First Multipoint Videoconferencing Bureau Service in Europe

BT has launched Europe's first bureau service for managing videoconferencing between multiple sites over public networks. Organisations with videoconferencing systems at several sites in Europe can be simultaneously linked together for a meeting by using the Bureau's services.

The Bureau, which can link up to seven locations at any one time, offers customers a choice of meetings—voice switched, where the picture displayed follows the conversation automatically from site to site; and broadcast, where one channel is held permanently open and is not affected by talking at the other sites.

The Bureau dials each location in turn and brings them into the conference. Time on the network is pre-booked with the Bureau, which then manages the call from BT's management centre in London. Calls can take place at one of two data rates: 128 kbit/s or 384 kbit/s depending on the quality and cost of call required.

The advantage to customers is that BT is putting the high-cost intelligence needed to link multiple sites into the network on a pay-as-you-use basis. This can work out much cheaper than installing at the customer's premises.

## BT Launches Two Category 5 Ranges to Handle ATM

BT now offers customers two 100 Mbit/s cabling solutions with the launch of its OSCA and AT&T's Systimax™ Category 5 infrastructures.

Category 5 cabling schemes are designed to offer increased bit rate support to customers. They are the main focus for the ANSI X3T9.5 committee, defining the 100 Mbit/s copper distributed data interface (CDDI) standard and it is highly likely that ATM—the multi-protocol for voice, data and video applications—will be supported by Category 5 performance. Users also have the added assurance that both infrastructures meet or exceed existing EIA/TIA Category 5 standards.

Peter Crouch, product manager for BT's Premises Cabling Services, said: 'It is important that customers who wish to take advantage of new high bandwidth services and applications ensure that the whole of their new or upgraded cabling infrastructure is compliant with Category 5. This applies to the cable used, to its connecting hardware and to the competent installation, which can only be provided by an expert supplier.'

Although the OSCA CW1750—BT's Category 5 cable—was launched last year, it is only the more recent technical advances in connectivity hardware that have enabled the introduction of the complete portfolio. Components including modular patch panels and cord connectors have been developed at BT's Birmingham and Martlesham Heath laboratories to meet the Category 5 standard. In addition, the new portfolio is compatible with installed systems design and topology, ensuring simple interfacing into existing systems so that they can be easily upgraded.

## Benefiting from Intelligent Networks

Europe's businesses must pressurise telecommunications operators and regulators to deliver the benefits of intelligent networking now, says Analysys, the telecommunications consultants in a new report published in June, and they may have to wait longer than their US competitors to reap the commercial benefits of the advanced intelligent network (IN).

A new generation of international telecommunications standards, known as the *advanced intelligent network*, promises to bring businesses a wide range of benefits from services which will be more functional, more highly customised, and more aggressively priced than today's offerings. Advanced IN services will build on existing switched-based services, but will be more flexible and more readily tailored to customer needs. They will include:

- personal call-management services, such as call forwarding, calling-line identification, call screening, last-caller recall and personal numbering;
- virtual network services such as a wide-area Centrex and virtual private network, which replicate the features of private networks and PABXs on the public network; and
- advanced number-translation services such as advanced freephone and premium rate, which allow call routing to be varied according to various parameters.

The Analysys report provides a comprehensive survey of the capabilities of advanced IN, the development of standards, the strategies of the major telecommunications equipment manufactures, and the likely pattern of deployment in Europe.

## TUA *Information on the Move* Report

Mobile data will have a significant part to play within the changing market for mobile communications services in the 1990s, according to a report published by the Telecommunications Users' Association. The report, *Information on the Move*, examines the existing and potential applications and services available from the various mobile technologies which will allow users' mobile workforces to send and receive information. Despite the potential for mobile services, the report also highlights the increasing confusion among users and concludes that unless certain barriers are overcome, mobile data could face a difficult period of introduction.

## AT&T Goes Global

AT&T has launched WorldSource, a new family of global customised voice and data services. So far, AT&T has recruited Japan's KDD and Singapore Telecom to its partners programme. Australia's Telestra, Canada's Unitel and Korea Telecom have also said they plan to join. As yet, AT&T has no European partners—but it is calling for European operators to join. The first services, to be available this year, include virtual network services for voice and data communications, private-line services for data and voice and frame relay services.

AT&T aims to start offering WorldSource later this year in North America and the Asia/Pacific region, through alliances with other telecommunications operators, and hopes to extend the services to Europe next year. WorldSource will be packaged separately from the company's existing voice and data offerings, although a spokesman said that AT&T would try and migrate existing customers up to WorldSource.

## Numbers Up

The prospect of personal numbering and other new services has been outlined in a new OFTEL consultative document, published in June. The paper, *Numbering: Choices for the Future*, proposes a further two-digit prefix, providing a framework for new services such as mobile, personal numbering and specially-tariffed services. Don Cruickshank, Director General of Telecommunications, said that by allocating a personal number for life, family members can choose their own ringing tone and easy access to an exciting range of new services.

'As competition increases, new network operators will need large blocks of numbers for their customers, and this scheme will leave plenty of capacity for new and innovative services as they develop.

'From 1994, telephone numbering, a national resource, will be managed by OFTEL which will make allocations to operators.'

The proposals are unlikely to take place before 1996.

## Broadband in Europe

In a newly-published report, *Broadband in Europe: Vision and Reality*, the Yankee Group Europe believes that widespread deployment of residential broadband networks based on optical fibre will not begin in most parts of Europe until after 2000.

Instead of a unitary network reaching everybody, referred to as the *broadband integrated services digital network* (B-ISDN), an alternative vision of broadband based on discrete overlay networks is emerging, providing service only to those with a clear and demonstrable need for high bandwidth.

Market forces will make broadband happen in Europe, and it is likely to be a piecemeal broadband that, instead of binding all users into the same economic club in the same way that the voice telephony network did, will serve separate and unequal interests with separate and unequal means.

The report measures the market potential for broadband services in Europe and considers two alternative scenarios for its development.

## DTI Awards Four More PTO Licences

The Department of Trade and Industry has awarded four new UK telecommunications licences. Three cover the provision of international satellite services, while the fourth allows the creation of a metropolitan area network in London.

City of London Telecommunications Ltd (COLT) is 90% owned by the US Fidelity Management and Research Corporation and intends to provide business services in London via point-to-point optical-fibre lines at all levels from simple ring down circuits to high-capacity links of 2, 8, 34 and 155 Mbit/s. The network will give access to both national and international carriers.

The company says it will also customise configurations for businesses needing higher bandwidths or other specialised arrangements. The network architecture will be based around the synchronous digital hierarchy (SDH) standard. COLT has started construction of the network, which is expected to go on-line towards the end of the year.

The three new satellite providers are Satellite Information Services (SIS), ESAT Telecommunications Ltd and PanAmSat LP.

## Tunnel Vision

Eurotunnel Plc/SA has signed agreements with British and French telecommunications groups for their use of optical-fibre telecommunications links routed through the Anglo-French Channel Tunnel scheduled for use in early 1994. Agreements are with BT, France Telecom and Mercury Communications. The cables will provide an alternative to submarine cables currently used for channel traffic.

## New Satellite Standard for X.400

A new international standard will allow users of INMARSAT-A and INMARSAT-M mobile satellite communications systems to access electronic mail and directory services.

Announced by the Asynchronous Protocol Specification (APS) Alliance, an international partnership of hardware and software vendors, service providers and user groups, the new specification will make it possible for users of the INMARSAT system to benefit from a variety of X.400 multimedia messaging applications. These include electronic mail, electronic data interchange, voice images, and facsimile.

Previously, no standard for X.400 communications via dial telephone lines existed and X.400 communications has typically required leased-line X.25 connections used to transport varying amounts of data via public packet switched networks.

'This specification opens up the large potential market of telephone users, including INMARSAT-A and INMARSAT-M customers, to take advantage of the off-the-shelf X.400 products and services,' said Chris Howard, manager of data services. Ships' captains will now be able to run a fully-equipped office while at sea; travelling business people will be able to take not only their telephone and fax capabilities with them on trips, but also their computer links. Large civil engineering and natural resource projects will be able to set up fully-capable offices in the field without a telephone line.

Originally developed for the maritime market, INMARSAT-A supports high-quality direct-dial telephone, telex, facsimile and data services. Transportable versions of INMARSAT-A terminals now fit into one or two suitcases, with folding antennas.

INMARSAT-M, introduced this year, provides telephone, facsimile and data services to compact low-cost briefcase-size terminals—the world's first portable satellite telephone.

London-based INMARSAT, an international cooperative of 67 nations, operates a network of satellites that provide global overlapping coverage.

## OFTEL Calls for 'Open' Interconnection

The UK Office of Telecommunications (OFTEL) has called on BT to publish the prices it charges other carriers for interconnecting with its network, and to charge them at cost price. To this end it wants BT to publish separate accounts for its network arm and the retail segment responsible for setting tariffs and billing customers.

The proposals are contained in OFTEL's second consultative document on interconnect pricing, *Interconnection and Accounting Separation.*

OFTEL expects information resulting from accounting separation to be provided by the end of the current 1993-94 fiscal year, but recognises that moving to full separate accounts could take longer. It will change BT's licence to require the company to publish its network charge before it introduces any new retail prices and to make that charge available to all interconnecting operators on a similar basis.

OFTEL wants interconnection arrangements to meet four key criteria: they should be transparent and the charges published so they relate to costs; they should be set at levels that are efficient and sustainable so that no under- or over-recovery of BT's costs will result; arrangements should not be unduly discriminatory either between competing operators or BT and other operators; and sufficient information should be available to give operators confidence in interconnection arrangements with BT.

## New Services and Tariffs for Vodafone

Vodafone has revealed plans for the launch of its new digital cellular services and announced revised tariff structures for all its services.

Its pan-European GSM service, to be known as *EuroDigital*, will appeal to subscribers who want to roam throughout the UK and into Europe and who require enhanced speech security.

Existing users of the Vodafone network will need a new cellular handset to use the EuroDigital service but will be able to transfer their current mobile telephone number.

The micro-cellular network, *MetroDigital*, is a unique service for subscribers who are mainly urban-based. From 1 October 1993, MetroDigital will offer more affordable monthly rental and call charges in the urban areas of the UK. Subscribers will also be able to access the EuroDigital service in the rural areas and all other pan-European GSM networks when required. Subscribers to the MetroDigital services will still have the same high level of speech security as EuroDigital subscribers.

## Towards Global Localisation

*Philip Cooke, Frank Moulaert, Erik Swyngedouw, Olivier Weinstein and Peter Wells*

Written by a team of acedemics from both France and the UK, this book explores the accelerating industrial trend to 'go global'. The authors ask whether, in so doing, companies lose touch with the locales in which they operate, or whether globalisation makes some locations more valuable than others. To support their arguments, the authors draw on case material from the computing and communications (C&C) industries, especially from their home countries—the largely centralised regime in France, contrasted with a much more open-market philosophy in the UK. The analysis is particularly concerned with the joint impact of regulatory pressures on the one hand and commercial imperatives on the other.

It has to be said that the book is not an easy read. The first few chapters take the reader through the various stages of industrial development, with frequent reference to earlier academic work on the subject with which non-specialist readers are unlikely to be familiar. The authors show how Fordism, the type of structured manufacturing associated most closely with mass production of motor cars, but subsequently adopted in many other industries, is no longer appropriate in an age where consumer choice has greatly increased and manufacturers must be much more flexible in order to remain competitive. Our own industry has undergone significant change, and the opening up of telecommunications markets has forced carriers not only to look outside their home markets for customers, but to shop more widely for goods and services. This has had a major impact on the telecommunications manufacturing sector, as evinced by the emergence of new alliances.

The authors also show how the computing industry has undergone major change. To some extent this parallels the telecommunications industry. Unlike telecommunications, however, competition has always been much more prevelant in computing, spurred on recently by the advent of personal computing, pressure for open systems, and customer demand for complete solutions (systems integration). These pressures have brought about substantial change in the industry, with alliances, company failures, and acquisitions becoming commonplace.

*Towards Global Localisation* winds up with a look at the C&C services sector, where computing and telecommunications become much more interlinked. This sector is characterised by high growth, but is far from mature so it is rather early to draw conclusions about how the service business will look in years to come. Multinational customers demand consultancy and systems integration on a global basis. At present it seems that the hardware manufacturers are best placed to offer this. There are many smaller players who have entered the sector from pure consultancy, but they do not have the resources to take on major international projects, except perhaps by working together. In summary, the book concludes that both computing and communications have been heavily influenced by commercial pressure (high development costs, convergence of computing and communications, customer pressure, etc) which have wrought very significant changes.

Although *Towards Global Localisation* is a useful contribution to economic and geographic thinking, and brings a lot of new material to the debate, its analysis is far from complete. There are many 'hidden' government influences which may have had at least as much impact on industrial development as the more overt influences discussed in the book; the concentration of UK government research and development spending, particularly for military purposes, along the M3 and M4 corridors, has been recognised elsewhere as doing much to support the concentration of high-technology industries in this region.

The book also fails to make a convincing case in arguing from the specific to the general. There is no obvious reason why what is true of the C&C industries should be equally true of other industries, many of which will be at a different stage in their maturity and subject to very different external influences.

*Published by UCL Press.*
*£30·00. xi + 227 pp.*
*ISBN 1-85728-000-8.*

***Reviewed by Don Field***

## European Telematics—The Emerging Economy of Words

*J. Jouët, P. Flichy, P. Beaud (Editors)*

The title is misleading as this book almost exclusively deals with the development of the Teletel service in France. Little information is given about services elsewhere in Europe, although one chapter compares the development of Prestel in the UK and Bildschirmtext in Germany with the Teletel service.

The book is a compendium of a number of articles written for a technical journal and thus is not well structured. In addition, the translation from the original French is not perfect, making it awkward to follow in parts.

While it describes both the technical and commercial developments of Teletel, it omits any up-to-date information on the costs and revenues. However, it does provide an interesting insight into the Teletel service, pointing out the political and commercial factors which influenced its development. One chapter compares the development of videodisc and videotex, pointing out how the commercial interests of the different parties involved shape and eventually decide the fate of new products.

The book will be of interest to anyone who seeks the holy grail of a commercially successful videotex service.

*Published by Elsevier Science Publishers.*
*US$ 84·50; Dfl. 165·00.*
*ISBN 0–444–89151–X.*

***Reviewed by Bob Foster***

# IBTE

## Retired Members

The following IBTE Members have retired from BT and retained their membership.

Adcock, R C
Atkins, M E
Belt, J
Bloxham, G
Boddy, C G
Bowe, D N
Burrows, S J
Callahan, P A
Carter, S J
Clarke, W B
Collier, M A
Cook, B C D
Crittenden, R S
Davidson, L A
Drewell, P W R
Dutton, R H
Egan, A J
Ford, M R
Good, B G
Harris, A N
Harrison, G
Hayes, B
Hughes, A R
Jackson, D A
Jackson, R
Jenkins, J G
Jenkins, P D
McKenna, K
McPhillips, J
Mothersole, H R B
Newberry, D
Nunn, C F
Oliver, G P
Oodan, A
Parker, J V
Pilgrim, M
Plyming, L J
Ray, T K
Reed, M
Robinson, J
Salmon, D J
Sewell, A F
Sheather, C
Shepherd, K F
Soames, S T
Spencer, V A
Stephenson, J
Storey, J D
Sutton, J
Swain, R S
Taylor, A R W
Titchmarsh, D
Wadeson, C J
Wildman, T A
Williams, E M
Williams, J F
Woodhouse, M H
Wright, G

Members wishing to contact retired colleagues should write to the Administration Office, Post Point G012, 2–12 Gresham Street, London EC2V 7AG.

## Deceased Members

It is with regret that we report the deaths of the following Members:

Arbuthnott, D Y M
Bailey, K H
Baker, P W A
Bartholomew, A J
Boocock, R O
Bray, P R
Brown, J H
Chasmer, D F
Collins, K P O
Core, D
Dhaliwal, D S
Garner, D J
Hamilton, R N
Hay, J
Holmes, D J
Hubbocks, L W
Ide, M D
Lewin, J
Morris, J M
Noble, F D
Parkinson, A R
Parsons, D J
Purvis, T A
Rae, W I L
Reynolds, M
Smith, J F
Smith, W
Tite, P G
Titman, B A
Webb, G N
Welsh, T
Williams, H
Wright, A

# next issue

Articles planned for the October 1993 issue of the Journal include:

- The Global Network.
- Planning the International Network.
- Bid Management.
- Telconsult.
- Caller Display.
- SuperJANET.
- Speech Recognition for Speech Services.
- Outsourcing Service and Information Technology—Part 2.
- Internodal Signalling.
- Telecommunications Standards for Europe.

[*Editor's Note*: Final contents may be subject to change.]

# notes and comments

Contributions of articles to the *Journal* are always welcome. Anyone who feels that he or she could contribute a telecommunications-related article (either short or long), which may embrace technological, commercial and mangerial issues, is invited to contact the Managing Editor, *BTE Journal*, Post Point G012, 2–12 Gresham Street, London EC2V 7AG (Tel: 071–356 8022; Fax: 071–356 7942). Guidance notes for authors are available and these will be sent on request.

The Board of Editors is particularly keen to receive article from the field. For example, novel solutions to field problems could form the basis of very interesting articles. Items of this nature would be very welcome, and potential authors are encouraged to contact the Managing Editor.

**BRITISH TELECOMMUNICATIONS ENGINEERING** ISSN 0262-401X

Published in April, July, October and January by *British Telecommunications Engineering Journal*, 2–12 Gresham Street, London, EC2V 7AG. (Formerly *The Post Office Electrical Engineers' Journal* Vols. 1–74: April 1908–January 1982.)

The Board of Editors is not responsible for any statements made nor the opinions expressed in any of the articles or correspondence in this *Journal*, unless any such statement is made specifically by the Board.



Printed in Great Britain by Unwin Brothers Limited, The Gresham Press, Old Woking, Surrey, GU22 9LH.

**Subscriptions and Back Numbers**
Price: Single copy—companies, universities, libraries and other bodies £5·00 (£5·75 including postage UK, £7·00 including postage overseas); private individuals (paid by personal cheque) £3·50 (£4·25 including postage UK, £5·50 including postage overseas). Annual subscriptions (including postage)—companies etc. £23 UK, £28 overseas; private individuals (paid by personal cheque) £17 UK, £22 overseas.

Overseas customers can pay by sterling drafts drawn on London banks or by sterling Eurocheques.

Price to BT staff: £2·25 per copy.

Back numbers can be supplied if available at the single copy rates given above.

Orders, by post only, should be addressed to *British Telecommunications Engineering Journal* (Sales), PP: G012, 2–12 Gresham Street, London EC2V 7AG.

Remittances for all items (except binding) should be made payable to '*BTE Journal*' and should be crossed '& Co'.

**Advertisements**
All enquiries relating to advertisement space reservations should be addressed to The Advertisement Manager, *British Telecommunications Engineering Journal*, PP: G012, 2–12 Gresham Street, London EC2V 7AG. (Telephone: 071–356 8050. Fax: 071–356 7942.)

**Communications**
All communications should be addressed to the Editorial Office, *British Telecommunications Engineering Journal*, PP: G012, 2–12 Gresham Street, London EC2V 7AG. (Telephone: 071–356 8050. Fax: 071–356 7942.)

**Binding**
Readers can have their copies bound at a cost of £19·00, including return postage, by sending the complete set of parts, with a remittance to Pressbinders Ltd., 8 Newington Industrial Estate, Crampton Street, London SE17 3AZ.



# THE INSTITUTION OF BRITISH TELECOMMUNICATIONS ENGINEERS

## IBTE Local-Centre Contacts

The following is a list of Local-Centre contacts to whom enquiries about the Institution may be directed. Where no Membership Secretary details are shown, membership enquiries should be directed to the Local Secretary.

| *Centre* | *Local Secretary* | *Membership Secretary* |
|---|---|---|
| Aberdeen | Jim Martin (0224 752688) | George Cameron (0224 752857) |
| East Anglia | Terry Birdseye (0702 373330) | Keith Phillips (0206 717244) |
| East Midlands | Dave Bostrom (0691 666501) | Ian Bethell (0602 478587) |
| Lancs & Cumbria | Trevor Hughes (0706 40840) | John Nicholson (0254 666237) |
| Liverpool | John Johnson (0925 415705) | Clive Maude (051–229 4074) |
| London | Mike Burgess (071–587 8147) | Peter Martin (071–492 6138) |
| Manchester | John Halton (061–200 9216) | |
| Martlesham Heath | Kevin Rose (0473 647534) | Ian Gilbert (0473 645500) |
| North Downs | Nick Smith (0227 474823) | |
| North East | Richard Jackson (091–261 3560) | |
| North Wales & Marches | Peter Clay (0743 274205) | |
| Northern Ireland | David Elliott (0232 214719) | |
| Scotland East | Graham Neilson (031–668 5878) | Lewis Shand (031-668 5482) |
| Severnside | Ian Davis (0272 206701) | Dean Shephard (0272 206457) |
| South Downs | Graham Lindsay (0273 222234) | |
| South Midlands | Jim Coley (0234 274840) | Keith Sanford (0234 274043) |
| South Wales | Peter Coleman (0222 514524) | Keith Voyce (0443 480033) |
| Staffordshire | Ray Piper (0785 813483) | Paul Field (0785 762419) |
| Thames Valley | Stephen Graham (0252 337104) | Dave Prout (0734 501244) |
| West Midlands | Gary Chattaway (0203 228396) | Paul Jervis (021–233 8162) |
| West Scotland | Graham Wellby (041–220 3997) | Jill Maxwell (041–220 5837) |
| Westward | Rob Rand (0392 212681) | Chris Gould (0392 212663) |
| Yorks & Lincs | Steve Wood (0532 378316) | Paul Horncastle (0532 376548) |

## Associate Section Zone Committee Contacts

The following is a list of Associate Section Zone contact points to whom enquiries about the Associate Section should be directed.

| *Zone Committee* | *Contact* | *Telephone No.* |
|---|---|---|
| London | Terry McCullough | 081–456 6798 |
| Midland | John Sansom | 0604 230635 |
| North East | Tim Toulson | 0742 708037 |
| Northern Home Counties | Andy Edmonds | 0473 645171 |
| Northern Ireland | Brian Walker | 0232 232565 |
| North West | Phil Holt | 061–600 8111 |
| Scotland | Bill Lindsay | 0382 302629 |
| Southern Home Counties | Martin Harvey | 0424 752444 |
| South West | David Sanders | 0272 230729 |
| Wales | Ferg Brown | 0952 249886 |

## IBTE National HelpLine — 071–356 8008

# IBTE SALES ITEMS

The Institution has a range of special IBTE items for sale. Members wishing to place an order should photocopy this page and on completion send it to the Institution Office located at Post Point: G012, 2–12 Gresham Street, London EC2V 7AG. Please note that the list given below contains revised prices effective from 1 July 1993.


Please supply the following items:

| ITEM | COST | QUANTITY | TOTAL COST |
|---|---|---|---|
| Notebook | £4.00 | | £ |
| Notebook Refill | £0.30 | | £ |
| Personal Organiser | £16.50 | | £ |
| Money Manager | £13.00 | | £ |
| Key Case | £3.00 | | £ |
| Credit Card Case | £3.50 | | £ |
| Quadram Pen and Pencil Set | £3.00 | | £ |
| Ballpen | £0.45 | | £ |
| Golf Umbrella | £10.50 | | £ |
| Silk Tie, Plain Blue Design | Sorry no longer available | | |
| Silk Tie, Blue Chevron Design | £13.50 | | £ |
| Polyester Tie, Plain Blue Design | Sorry no longer available | | |
| Polyester Tie, Blue Chevron Design | £4.00 | | £ |

Name ______________________________

Address ______________________________

______________________________

______________ Postcode ______________

I enclose a cheque for £ __________

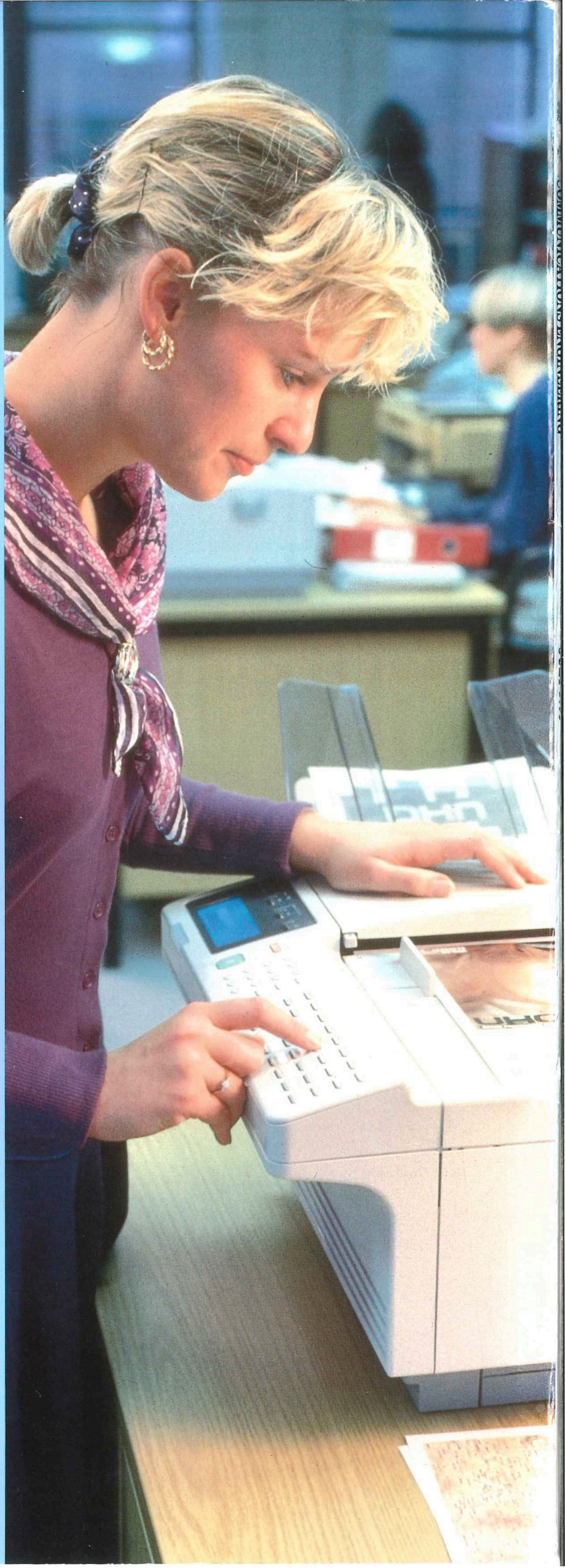
(cheques payable to 'IBTE')

Signed ______________________________

VOLUME 12 PART 2 JULY 1993

# *Contents*


| | |
|---|---|
| Guest Editorial: Managing Customer Relationships | 81 |
| Account Management in BT | 82 |
| Systems Engineering in BT's Account Management | 87 |
| The Office You Wish You Had | 91 |
| Corporate Visual Services—An Overview | 97 |
| ISDN in the Dealing Room | 102 |
| Assessment of Network Performance: The ISDN2 Performance Analyser | 110 |
| Standards for ISDN Architecture | 114 |
| New Road and Street Works Act | 122 |
| Outsourcing Service and Information Technology Analysis—Part 1 | 132 |
| A New Cooperative Framework for European Public Network Operators | 141 |
| A Method for Compatible Coding of HDTV and TV | 146 |

**The Journal of The Institution of British Telecommunications Engineers**